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Scientific Research for The Linen Trade

RE-PRINT OF ARTICLES
WRITTEN FOR
THE PROVISIONAL
RESEARCH COMMITTEE
BY
JOHN C. CONTEE

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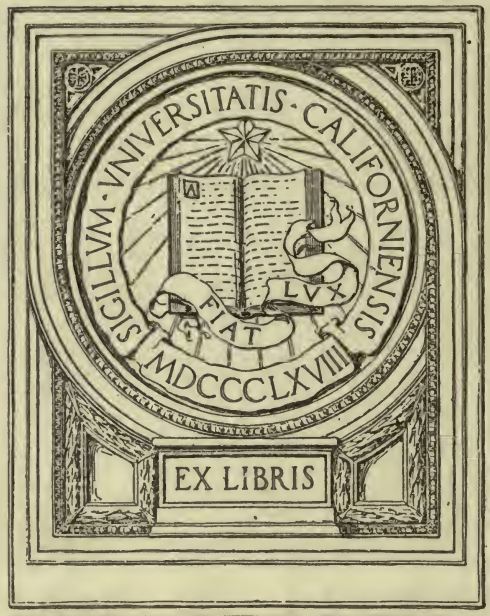
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SCIENTIFIC RESEARCH
FOR
THE LINEN TRADE.

RE-PRINT OF ARTICLES
WRITTEN FOR . . . .
THE PROVISIONAL . .
RESEARCH COMMITTEE
BY . . . . . .
JOHN C. CURTISS . . .

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INTRODUCTION.

WHEREVER we turn we find people considering—as it is right they should—what are the lessons of the war, because it is realised that if these lessons are misunderstood or laid aside nemesis under the new conditions must follow such neglect. Men of insight and enterprise are, therefore, everywhere casting searchlights on whatever fields of activity chiefly concern them, for the purpose of determining what new principles must be there applied, what old methods have to be scrapped, and how the necessary alterations and repairs may most effectively be made.

It would be surprising if in all this ferment Ulster were to appear stagnant, lethargic, or unintelligently blind to the signs of the times. This book, produced in the interest of her great historic industry, the Linen Trade proves that Ulster is open to no such reproach. She is wide awake. She is anxiously scanning the horizon ahead, fully alive to the fact that her prosperous past is no sufficient guarantee for an equally prosperous future if the present critical juncture in the industrial history of the world is not handled to her advantage.

Whatever else the war has taught us, it has impressed on our minds more than ever before the need for efficient organisation in all great under-

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takings whether of war or peace, and the advantage over competition possessed by him who makes the most thorough use of up-to-date scientific equipment. The supreme importance of organisation and science was recognised in Germany far more than by ourselves before the war, and it was this that beyond anything else engendered the arrogant belief of Germans in their own superiority to the rest of mankind. Happily, when the need became pressing the British nation proved itself more than equal to Germany in capacity both for organisation and for applied science, not only in relation to military administration, but also to the whole management of industry and commerce when confronted with an unprecedented upheaval of world conditions.

The danger, now that the urgency of that ordeal is past, is lest we slip back into the old habit of slack, unorganised competition among ourselves, instead of adapting to the purposes of peace, with whatever modifications may be advisable, the scientific methods suggested by recent experience.

This does not mean that Government control of industry should be continued. Far from it. Government control, unavoidable under the conditions of world-wide war by land and sea, would stifle trade instead of expanding it, when markets have again become normal. Not control but free organisation is what our post-war industries will require. Organisation means the substitution of co-operation

for competition. There will be plenty of competition—keener than ever before—but it will be competition internationally between industries as a whole, or groups of industries, in which we must be prepared to find Germany before long taking again a prominent place ; for she is far from being reduced to commercial impotence. It is in order to be able to meet this foreign competition with our industry that we should as far as possible eliminate competition within the industry itself at home. In all industries there are a number of more or less closely related sections or branches, whose particular interests are to some extent conflicting ; but it will always be found that the interest which they all have in common covers a much larger and more important area.

The Linen Industry of Ulster is no exception. It embraces the flax-grower, the scutcher, the spinner, the weaver, the bleacher, and so forth. If the industry as a whole were organised on the basis of its common interest, co-operation between these various grades in the manufacture of linen would take the place of competition which tends to depress each of them at one time or another, and to weaken the trade as a whole. All would gain by organisation which would safeguard the individual interest of each, and which would place the Linen Trade, as a great national industry, in a position to face those powerful foreign combinations, whose size and

financial strength, staffed as they are by highly trained scientists working in first rate research laboratories, enable them to standardize and produce on an extensive scale, and to expend large sums on propaganda and the investigation of markets.

Ulster is to be congratulated on the characteristic enterprise and foresight which her leading industry has shown in tackling these problems without waiting for the return of peace. The Articles by Mr. Curtiss, published during the war in the local press, and now reprinted in a more permanent form, display a masterly grasp of the subject, and are creditable to the Provisional Committee on Research, who obtained their publication on behalf of the Linen Trade, which they represent. It is satisfactory to find in them a clear realisation that any efficient organisation of the Trade will involve complete co-operation with the Labour employed, and a resolve that the highest possible reward for their work must be secured to all concerned in the Industry. On such a basis it ought to be possible to maintain a maximum output, without which no great industry can look with any confidence to the future.

I hope that the re-issue of Mr. Curtiss' articles in the following pages will make his able survey of the situation more widely known among those best able to appreciate their value.

EDWARD CARSON.

January, 1919.

SCIENTIFIC RESEARCH AND THE : : LINEN INDUSTRY.

A BRAHMIN PRIEST, a thousand years before Christ, wrote a great epic poem of many volumes, and the striking thing about it was his wonderful description of perfection. It was as if our idea of the best were a perfect circle which, as a circle, cannot be bettered. When the Greeks reached their highest perfection in architecture they had designed that which they thought could not be surpassed. The proportions conceived by them remain in this twentieth century as an acknowledged standard of perfection.

Industry is not, however, governed by mathematics, but by imagination and research. Thus, having attained what may be considered by some as perfection, someone comes along with breadth of imagination, and by research is able to pierce through the wall of limitations and open up entirely new avenues for industry.

The industry that gains commercial supremacy is the one able to break through the limits of the past and acquire new elements with which it may outstrip its rivals in production, or mayhap discover

entirely new products which in themselves will revolutionise the industry.

Recent Discoveries

So in the manufacture of iron and steel we have seen during the past sixty years the discovery of the Bessemer process, and its improvement by Thomas & Gilchrist; the introduction of electric rolling mills, the invention of the Bonecourt furnace for giving much greater efficiency in the use of fuel, the utilisation of microphotography in the analysis of metals and alloys, and the production of high-speed steel. In the engineering industry we have seen the introduction of the steam turbine and the internal combustion engine. In the chemical industry we have heard of the discovery of viscose, a large number of high explosives, new dyes, and drugs of inestimable value for the prevention and cure of disease. We have seen electricity in our own generation developed for new economic uses in countless ways — electric lighting, electric heating, electric driving, electric traction, telephony, and wireless telegraph.

The great war to come for commercial supremacy demands broad mental vision on the part of your manufacturers—yes, even of the flax growers. The leaders of the linen industry see clearly ahead, and are laying down the road on which the others may travel. But why should any hold back? Why can they not eliminate from their minds those petty, narrow views towards progress which retard

industry and give their enemies a chance to forge ahead? Why should man allow jealousy to make him miserable and stand in the way of success? Why should he hold his eyes so close to the surface that he cannot take a broad survey of what is ahead of him? Why should new methods frighten him, and ultra-conservatism become bonds which hold him fast to the starting-post? These must be severed, or else he cannot run in the race for the great prize. Why do some men hold back when the rest want to go forward?

Some men do not like changes, but they will come whether or no; but if they do come too late for your own good, you have only yourselves to blame. Are the discoveries which lead to progress to be all developed in Germany and America? And when they have been made, are the men of the linen trade going to see them exploited by the Germans in the same old way that so many of your good British inventions have been exploited abroad because your own people lacked the imagination to exploit them themselves?

Mr. Gordon Selfridge says in his "Romance of Commerce" (written before the war): "The world wants another flood, a great mental torrent to wash away the accumulations of false ideas, the obstacles, the traps, which trip and hold fast against progress. Oh for a mental giant who can

brush away this wall of limitations and give us new ideas of life!"

Armageddon

The one blessing of Armageddon is that it has been the giant, and that the flood that has torn away the barriers that stood in the way has rudely awakened us to the fact that this war is a survival of the fittest. It has opened our eyes to the great opportunities for those who have the nerve to tackle them, which mean new problems, new methods, and faith to move on into the open, away from the old homestead.

Ground for Research

No keen man really thinks that the linen trade has reached the millennium of achievement, and that there is nothing further to be known about flax and its manipulation. Organised research can and will make great discoveries still in flax-growing, in mill process, such as spinning and the manufacture of fabrics; in the finishing processes, as bleaching, dyeing, etc. Linen has been the aristocrat of fabrics, but its uses have been too limited. The market can be increased manifold by scientific organised effort.

There is a great territory marked out for exploration. The linen trade touches the boundaries of science at many different points. These divide under several heads — bacteriological, biological, botanical, chemical, physical, mechanical, geological, and geographical, to mention some of them.

Each of these has secrets of value to the trade

if you will discover them. The trade alone cannot discover them, but only the trade in close and intimate alliance with scientific research. Individuals alone cannot find out these secrets, but only individuals banded together as you will be in an association for research.

This, then, is the reason for having an association for scientific research. It will be the keystone of the linen industry in the future.

SCIENTIFIC RESEARCH AND PREPAREDNESS.

Need for Organised Preparedness

THE fact that there have been two misconceptions regarding scientific research is as interesting as they are erroneous, though it is easily understood why some people might hold to such views. The first notion is that research work is not necessary in the face of the present finality of achievement, and consequently would be a waste of money; the second is that science is something subtle, mysterious, and difficult to understand, therefore should be left alone.

It is true that your linen trade has reached a high level of production, and that the machinery used is the most scientific that can be had; but this is only the evolution of old ideas conceived years ago, since which time other industries have been swiftly moving along newer paths of progress. They have reduced costs by the discovery and use of by-products, in some cases have revolutionised the whole industry, and often have increased the material wealth immensely. There should be nothing mysterious about scientific investigation which will result in greater preparedness for the linen trade.

But preparedness for what?

Not for war! For peace, of course! Never before has a lesson been more thoroughly taught

than the lesson of preparedness as an essential to victory in any international undertaking.

Flax-growing, retting, scutching, spinning, weaving, bleaching, and selling are the fundamental principles of the industry; to each in turn the X-ray of research wants to be applied to discover its greatest efficiency if this trade is to hold its own the next fifty years. The present war is nothing more than a war of commercial competition. Such expressions as "a place in the sun," "the freedom of the seas," etc., refer to unrestricted commercial activity.

It is obvious, therefore, that the war of artillery and torpedoes on, under, and over land and sea is but a prelude for a more intensive and extensive contest for the commercial supremacy of the world.

Volumes have been written on the military unpreparedness of both England and America, a condition chiefly due to our imagined security against foreign attack. I have heard expressions of security from men in Belfast who really believe that after the war conditions will be the same, and that no special effort on their part is necessary to contest for the place of commercial leadership in the world's linen markets.

For forty years Germany has been preparing to attain political and commercial supremacy. Because of our lack of preparation we have paid a terrible price to hold our own against her; but we will win this war if it takes forty years more to do so.

Have we learned anything? What preparation are we making? What foresight are we showing against the next stage of the war with Germany—the war of commerce for industrial supremacy? Unless we win the next stage the advantages of the first victory will be negligible. It is well known that Germany has thoroughly organised her industries and cartelised them to recoup her war costs through world commerce. Whether this war proves the death-knell of Prussianism or not, all the ingenuity, research, and efficiency of Germany will be concentrated exclusively on commercial conquest later.

Haphazard Methods

What chance will haphazard methods have against organised rivals admitted to be the most efficient in the world? You as a nation, perhaps as a country, are far too conservative and slow. Even if the war has taught nothing else, every man should by now have realised the meaning of preparedness.

Now is the time for a complete reconstruction, from flax-growing to the doubling of your markets. After the war, perhaps sooner than we realise, international competition will be upon us again, keener than anything we have hitherto experienced, and the question is, How can this be met? Germany's policy for industrial expansion includes getting control of raw material, and already she has penetrated the Russian flax districts. Therefore

better methods, with more economical production, is of first importance if you are to retain your lead in the linen industry and be in a position to maintain a high standard of wages. Increased capital alone will not suffice, for capital without life-giving ideas is a dead thing. There are two factors which will accomplish all that is necessary, and the linen industry is going to carry them out.

Two Aims of the Research Association

One is combined organisation for the development of the linen industry from the ground up. This will be under the direction of the Association of Scientific Research, and will cover the various stages of manufacture, from cultivation of flax to the finished goods ready for the market. The other is combined organisation for the development of the linen markets, especially America, where the money lies, and where the great battle for commercial supremacy will be fought. Instead of exporting to the States, as you have in the past, only about £4,500,000 per annum, in spite of an enormously increased population and a tremendous increase in wealth, at the new values which are in operation, you will have to set your mark at £9,000,000 for the third year after the war, and this figure must increase annually if you are to keep machinery fully employed and keep ahead of the game. By efficient use of wise and practical scientific knowledge your linens will lead the world.

Preparations for Peace

Mr. F. W. Keeble, F.R.S., in his "Science and the Nation," just published, says:—It is the duty of men of British birth who cannot be engaged in seeking peace through victory in the field so to prepare that when peace comes it may be a herald of a new and better era in the annals of the Empire and civilisation."

Moribund industries will have no chance after the war, and the ultra-conservatism and procrastination should be scrapped with the old machinery about the place. As in preparation for war, so in preparation for peace, we can only maintain our supremacy by being alive and a little better than the other fellow. This can be accomplished by the carefully-planned, systematic, and continual application of science to the principles and practice of industry.

An End of Individualism

The time for individual firms to undertake the problems of individual commercial supremacy is past. Ruinous price-cutting must cease. Only by one grand, united effort all together in the theatre of the next great war can you hope to win, and your industry at home must have the vitality fused into its equipment that can only be supplied by a thoroughgoing scientific research department.

DEVELOPMENT OF INDUSTRIES.

THE mobilising of various allied trades into cohesive union in the form of an industry is but the natural result of an age of international competition for supremacy in the world's markets.

It is almost too academic for me to discuss the evolution which has led one trade after another to combine the different units of an industry so that it may derive both strength and power to develop in every department of its fabric. Both Germany and the States have developed highly-organised industries.

Birth of Era of Combination

Mr. J. H. Stirling, in his outgoing speech as president of the Belfast Chamber of Commerce, made this statement: "It is cheering to find that, even in that stronghold of individualism, of go-as-you-pleaseism—the Belfast linen trade—the producers are finding out the value of combination. One after another of the various branches of the trade are closing their ranks, and all experiencing the strength and value of being able to present an unbroken front to the enemy from whatever side he may come. Even the least hopeful section—the merchants—are at present considering a huge combined advertising scheme."

He stated further that he "would like, with whatever weight an utterance from the chair might be supposed to carry, to impress upon the Chamber

and upon the whole industrial community the absolute necessity of a strong and united effort for industrial research. That the formation of an Association of Scientific Research has already been born is now common knowledge. Germans have been able to fight the strong invested interests of England, even though they were late arrivals in the industrial field, because they have neglected nothing in order to win supremacy. Applied science has been to them merely one of the weapons in their industrial war."

Mr. Stirling further called attention to the fact that German scientists were no better than ours, but that German manufacturers had been more wide-awake and far-seeing. The pre-war attitude of the average British manufacturer towards applied science might have been described as a sort of amused tolerance.

Darwin has enunciated the hypothesis which has affected human thought in all directions.

Rapid Development of Science

The science of bacteriology has been built up, and the discoveries of Pasteur have been applied to the industries of brewing, viniculture, dairying, and the rearing of silkworms. Lister and others have applied the knowledge of bacteria to the prevention and cure of disease. Aniline dyes, whose invention was the work of an Englishman named Perkins, was developed into an enormous industry by Germany. Wrought iron has been succeeded by mild steel. Rubber is now an important essential in industry.

Internal-combustion engines, motor cars, aeroplanes, Zeppelins, turbine engines, X-rays, wireless, talking-machines, etc., etc., have come into being in the past few decades. Photography from a scientific curiosity has become almost indispensable in industry. The same is true of electricity, with all its ramifications of light and power, which is still in its infancy. All these and endless other things are the evolution of science and the result of the laboratory. The need of increasing output in all British industry is being realised, and the necessary conditions to that end are being explored by the Government Committee appointed to inquire into the position of national science in the educational system of Great Britain.

The report just published by that Committee (Cd. 9.011) states that " Rule of thumb methods are seen to be inadequate if industry in this country is to hold its own.

" The individualism which has heretofore characterised British industry is gradually giving way before serious efforts towards combination. With all this there is a growing consciousness of the need for organised research into the process of manufacture. Lately the community has come to realise as never before that the development of industry is the concern not only of individual employers or groups of employers, but of the nation as a whole."

Sir George Beilby pointed out that one-fifth to one-half of the 100 millions sterling which represents

the national bill for raw coal is being wastefully expended and might be saved, and that the saving can only be effected by the co-operation of a large body of trained fuel experts to carry out the necessary research and to introduce and supervise improved methods wherever fuel is consumed.

Before the war there were not more than half a dozen firms in nonferrous trades which had laboratories of their own, but in the near future there will likely be fifty. This is not my statement but that of Sir Gerald Muntz.

That the linen industry, with its vested millions, has not already had an association of research is of course unfortunate, and one which must quickly be changed.

What Scientific Research is

As early as 1900 the British Government recognised the importance of the Government lending its endorsement to scientific research, and they then established the National Physical Laboratory, which was the first instance of official recognition of this subject. The object was to bring scientific knowledge to bear practically upon our everyday industrial and commercial life, to break down the barrier between theory and practice, and to effect a union between science and commerce.

The original objects as stated were very academic, and not nearly thorough enough if Britain expected to acquire commercial supremacy for its industries. At that time the Government gave an annual allowance

of £4,000 per annum for five years; this in 1908-9 was increased to £7,000, and in 1916-17 the grant for aeronautical research alone was £10,400. The United States Government had endowed its Research Department with £100,000 per annum long before the outbreak of the war.

We cannot escape from the conclusion that scientific research can do much for the linen industry, both in the cultivation of the flax, its treatment, the extraction of valuable by-products which are now going to waste, also in its handling and manufacture, and the production of special machinery which will be evolved to meet new requirements of the trade.

RESEARCH IN OTHER INDUSTRIES.

AMERICA has shown the marked advantage to be derived from applied research work in her industries. Practically every industry and most large concerns have their laboratories where constant work goes on, week in and out, solving the problems of manufacture, and discovering occasionally new secrets which earn for the commodity a place in the sun of the world's commerce. In the laboratory of the National Canners' Association at Washington, D.C., there is the study of the action of foods on metals, examination of evaporated and condensed milk, and the weight and coating best adapted for the manufacture of plate for packing tins.

Value of Research as shown by Recent Events

In promoting scientific research for industrial purposes we must take big views; we must not be disappointed because immediate results of value are not forthcoming. Over and over again in the history of research, discoveries of great value have been stumbled on, as it were, in the course of some inquiry which was primarily directed to quite a different object. Faraday did not dream of the vast applications of electro-motive force when he first made a magnet revolve round an electric coil, and its possibilities are not yet fathomed. Scientific research proved its value in the early days of the war, and

the practical man of business, the manufacturer, and the trader soon discovered that without the help of the scientists they would not be able to continue because of the lack of certain essentials necessary to the production of their wares. The steel manufacturers were in grave danger from the possible exhaustion of the supply of chemical glass necessary for the testing of their materials and products. The Institute of Chemistry set up a Glass Research Committee under the late Professor Meldola, and so enabled Professor Herbert Jackson to indicate the detailed process of manufacturing a number of special glasses which were produced by a progressive firm. The Institute were able to assist the production of further glasses.

In the pottery industry the supply of seger cones necessary as a guide to the firing of their china and earthenware was cut off by the war, and they were threatened with closure for want of them; but Dr. Melbor, the principal of the Stoke Pottery School, was able rapidly to supply the need and manufacture sufficient cones for the whole pottery trade, which Germany and Austria had before the war captured by the control of these commodities. The Stoke potteries have established a Scientific Research Department encouraged by this success, and they should by the end of the war be able to manufacture hard porcelain with British materials so as to be in a position to compete with German

and Austrian manufacturers, and build up a new and probably more remunerative trade in place of the older trade in earthenware and the cheaper sorts of bone china.

It has, unfortunately, been the history of British industry that the trades have heretofore taken short views and felt little interest in systematic research or trade co-ordination so long as the industry seemed prosperous and their trade was not in immediate danger. This has been especially true when the firms were small or if the capital engaged had a speculative value on the Stock Exchange. For example, in the rubber industry I understand that, so far as the problems of the manufacturers are concerned, they have hitherto done nothing fundamental towards systematic research whereby the industry might reduce costs or discover valuable by-products. The manager of one of the relatively large rubber firms said that his people produced about £9,000,000 worth of 'bus tyres annually, and he was strongly of the opinion that it was desirable to attack manufacturing problems by research; but he said that even an academic research on the constitution of rubber would not be supported by the other manufacturers. It is true, however, that the Rubber Growers' Association have shown more wisdom, for they have raised the sum of £5,000 a year for research by levy on their members, the money to be spent chiefly on agricultural and allied

problems of rubber-growing and the preparation of the latter.

Effects of Organised Efficiency in Goodyear Tyre & Rubber Co.

Just for comparison, to show what results may be obtained by organised efficiency in all its branches: In the year 1898 Mr. Frank A. Seiberling founded the Goodyear Tyre & Rubber Co., of Akron, Ohio, with £700 of borrowed money, and a factory building for which he gave his notes for £2,000. His original staff consisted of seven people; he now employs 20,000 and last year did a business of over £22,000,000, almost twice the turnover of the linen industry. The assets of the Goodyear Company total more than £12,000,000. The Company employs 750 salesmen, has 20,000 acres of its own rubber lands in Sumatra, which require 3,300 men, and it is reclaiming 24,000 acres of the desert in Arizona for the growing of long-staple cotton. It owns a cotton mill in Connecticut.

Mr. Seiberling had a remarkable faculty for vitalising men. He is a profound believer in research and publicity, and is always looking ahead, never satisfied with the present. When solid rubber tyres were said to be the only kind that could be used on heavy trucks and buses he had his research department experimenting, which resulted in a few years in the production of some enormous pneumatic tyres—so big, in fact, that to the prejudiced observer they seemed grotesque and impossible. Attempts to puncture them with nail and hammer proved un-

availing. These tyres were the genesis of the Akron-Boston Highway Freight Line (900 miles), which was an innovation so amazing that even truck manufacturers were incredulous. Now the huge pneumatic tyres have been accepted by other manufacturers as the logical thing. His research department began experimenting years ago in balloon making at a time when this sort of thing was purely a tempestuous toy for adventuresome men. In 1917, when the United States came into the war, Mr. Seiberling and his people were the only ones in America who could make dirigibles.

Neolin soles for boots and shoes (a by-product) was another achievement of their laboratories which have met with marvellous success and cut deep into the leather industry, because it was introduced by an exhaustive educational sales campaign on its superior wearing qualities to leather.

Any industry is likely to be very hard hit from the most unexpected quarter by some new development of a by-product—a blow that might have a very serious effect if the discovery were made by an alien competitor. Another example is cellulion, a direct product from cellulose, which is likely to displace the whole of the new developments in woven material by the paper yarn process, and will be a serious menace to a sister trade of ours—the jute industry. Thus it behoves our linen industry, even as they have kept ahead of competitors, to maintain

that position, and, if there are any discoveries, to be the pioneers by means of research.

But to resume. Mr. Seiberling not only believes in scientific research but in advertising for creating a plus demand over supply, which at the same time maintains price and ensures high wages. Ten years ago the Goodyear Company spent less than £15,000 per annum on advertising; last year they spent the enormous sum of £400,000.

A few of Mr. Seiberling's slogans are worth repeating:—

"Imagination seeks to fecundate dormant fancy." "Lack of imagination is the loadstone of the average man." Imagination leads to team work." Success comes to him who can see beyond the so-called boundaries of the trade, and has the strength to assume responsibility." "I want men eager to shoulder loads involving great issues." "I would rather have ten men with enthusiasm germinated by imagination than a hundred men of the same abilities who have lacked the master trait."

Reluctance of British Manufacturers for Research

By some extraordinary converse the manufacturers of the old world shun changes, and even with the lessons of the war before them think that their own particular industry is safe enough. A year ago one of the biggest pottery manufacturers at Stoke definitely stated that he saw no reason for spending money on research work or attempting new kinds of goods, because his ovens were regularly employed to

the full. He explained—and this is significant—that research into the structure of ovens with a view to economy of fuel was too big a question for a single firm to tackle.

The report of the Committee of the Privy Council found that "manufacturers generally were unwilling to try new developments because they appeared to lack imagination or ambition for extension so long as their existing plants were fully occupied." However, the Stoke potteries have changed their attitude, as already stated.

Notwithstanding their great success the Scottish shale oil manufacturers have seen the necessity, and have, I understand, established a joint research committee, and are making arrangements for a combined research into some of the problems affecting their industry.

Since the war the Federation of Master Printers have discovered that several substances used by them have been solely supplied by enemy countries, and they are now desirous of finding a means for an independent source of supply.

Broadly speaking, it is evident that the difficulties of tradition, national temperament, and lack of trade organisation are responsible for the inertia which British manufacturers have shown towards research, and which stand in the way of proper co-operative effort, except in certain industries where the leaders are endued with sufficient imagination to see far

ahead (years in advance), and are strong enough to swing the others into line. It is incumbent on the leaders of British industry to accept advanced thought and to face their post-war problems squarely, with the realisation that only by so doing can the progress of the whole industry be assured. What will be the position of the linen industry ten or twenty years hence?

THINGS THE LINEN TRADE SHOULD KNOW.

YOU rightly flatter yourselves that in the linen trade you hold the premier position in the world. It is because you wish to continue to hold this position that it is imperative to apply scientific research to each process of manufacture in order to reduce cost to the minimum by making it possible to get the maximum of production from looms and spindles.

Necessity of Research to Discover New Phases of Development

Where have you acquired the knowledge and experience to put you on the high level on which you now stand? For the greater part it was handed down to you. The fact that a high degree of perfection was practically attained years ago is the real reason why you should now turn the searchlight of research on your present process of manufacture to discover new phases of development. Perhaps you cannot improve, maybe. But you ought to know.

You ought to know if there is any existing improvement of method; you ought to know if you are utilising all possible waste; you ought to know all the possible facts regarding flax and its by-products. You ought to know if there can be any new methods or inventions that will help the industry, or any new powers of application or outlets for linen which will assist in maintaining its commercial supremacy.

You cannot know these things in the routine of your busy lives unless you have men of trained scientific minds in bacteriology, biology, botany, chemistry, geology, physics, mechanics, and psychology. These men have acquired inquisitive minds; they think in an analytical way; they are for ever asking the questions, "Why?" "Why is this?" and "Why is that?" and they work for a day, a month, or years solving these questions. The answer may be simple, but it may be very important to the trade.

An Illustratio

I was shown a lump of hard wax the other day. It was a rich, dark-brown colour, almost identical with beeswax; it had been extracted from flax dust, of which it constitutes 10 per cent. For generations this wax has been thrown away—enough wax per annum, more than enough, to pay the bill of the Research Association each year. Extracted, it has a commercial value; left in the yarn, it makes bleaching more difficult; blown into the atmosphere, it is a nuisance.

You want to know the "why" of the bleaching action of bleaching powder.

You want to know the "why" of lime and soda boiling.

You want to know "why" lime-boiled cloth has a different physical appearance when bleached and finished than that which has been boiled in soda.

You want to know what is the exact cause of the brightening action produced in the final white sour

(sulphuric acid), or in fact each time the cloth enters this.

You want to know the "why" of retting, with reference to its effect on the cloth produced from the flax, from the bleachers' point of view.

What are Pectines?

You want to know what it is that makes linen so expensive to produce, and what it is that at the same time makes it worth producing even at its high cost. The pectine bodies contained in the flax plant have undoubtedly a very great deal to do with both questions.

Just what are pectines? You know that in a general way pectine is the gummy substance that binds together the ultimate fibres of the flax into long continuous ribbons which extend practically the length of the plant, and that connects these ribbons to the structure of the plant.

To say that that gummy substance is pectine does not get us any further. There is a great lack of knowledge of what it is exactly. Yet the manner in which it is acted upon in the retting process is the chief factor in determining the value of the marketable fibre.

The behaviour of the pectine bodies when passing through the hot water of the troughs is what makes wet-spinning possible.

Again, the modifications which these same bodies have undergone are no doubt largely responsible for

making a yarn or cloth easy to boil or bleach, or the reverse.

Here, then, is a substance, or group of substances, which directly affects the grower, the spinner, the weaver, the bleacher, and the merchant, and there is very little exact knowledge concerning it. Is it not worth some investigations?

How is pectine affected by the various industrial operations? To what extent does it hamper or facilitate them? How does its nature vary from crop to crop, from soil to soil, or from any other reason? It is hardly possible to conceive that thorough and patient investigations into these and similar questions would not be of incalculable value to the linen trade, and by solving a few of the problems they present we should bequeath a richer heritage to our sons.

Neglect of Science in the Past

Not only physics and chemistry but botany has been neglected. The very basis of the whole of the linen trade is a vegetable product, yet how little has botanical research contributed to the problems of flax-growing. Naturally the flax-grower has studied to some extent matters of immediate concern, especially the problems of yield, but even this study has been of necessity rather superficial investigation than deep-seeking research. Further, they have been hampered at all stages by lack of facilities for interchange of ideas with spinners, to whom quality is of equal concern to quantity.

The flax trade has made little use of the science of physics and the knowledge of exact measurements. The methods of treating textile materials, yarns, and fabrics have remained to a great extent undeveloped. To illustrate:—It is usual to test only the tensile strength of yarn before using it, but are there no methods available for testing the two equally important properties of resistance to friction and elasticity, both of which are of importance in the operation of weaving? What is termed elasticity in yarn is difficult to define. It exists in some yarns and not in others, although the flax fibre is almost devoid of this property. How, then, can yarns be spun to give this most necessary quality?

Any successful methods that have been discovered are mainly on the "hit or miss" principle, and your store of experience and knowledge has been derived from the accumulations of countless generations. The present generation has added little to that store compared with what might have resulted from a well-thought-out scheme of scientific research such as is now being proposed.

There seems to have been an established idea that some things can only be determined by practice, but we must remember that there is no change that takes place in any material fabric that does not fall under some natural law and is capable of being expressed by a formula.

SCIENCE AND FLAX CULTIVATION.

Importance of having Adequate Supply of Flax in United Kingdom. How can be done?

THE linen industry should never again be dependent for its main supply of raw material on outside sources. The question of an adequate supply of flax is of primary importance. Enough should be grown in the United Kingdom after the war to meet all needs, and this could be brought about by intensive methods, by seed selection, by proper use of fertilisers and by elaborating the flax extension scheme to cover the United Kingdom.

One of the fundamentals of scientific research will be the study of flax. We do not yet begin to know what can be produced by intensive scientific cultivation.

Mr. Hudson Maxim told of a New Jersey farmer who went to China, studied the art of fertilising and intensive cultivation from the Chinese, then returned to his farm in New Jersey, applied the principles to his land which he had considered worn out, and sold the year's produce of his 150 acres in New York city at the stupendous figure of £30,000.

It is undoubtedly true, and to our shame, that we have much to learn from the Chinese, Japanese, and unfortunately from the Germans, in the use of fertilisers.

During the last thirty years the general yield in agriculture per acre in the United Kingdom has

remained practically stationary, while that of Germany during the same period has gone up 40 per cent.—the result of applied science.

Germany has used artificial fertilisers to the extent of 105 lb. to the acre, while the farmers of the United Kingdom have been content with 48 lb. to the acre. Agriculture in Germany has not been allowed to stagnate or decay.

A more thorough knowledge of fertilisers by the farmer would surely lead to an enormously increased yield per acre.

You should endeavour in your Association of Research to bring about a revolution of flax production and quality of fibre. It is high time something was done.

As an example of the necessity for such research I will quote from the report of M. Alcan on the state of linen manufacture at the London Exhibition, 1862, fifty-six years ago:—"The lack of development of the flax industry between the Exhibitions of 1851 and 1862 so impressed the jurors at the latter Exposition that they asked for a special report on it. This was so important that it was published in full, but it is too long for me to quote. It stated that inferior seed had been used, with result, poor crop, etc., etc."; and also "that the quantity of goods actually produced is far from having made the same active progress as several other branches of textile manufacture. It has even remained almost station-

ary." This, bear in mind, was said fifty-six years ago.

Flax-growing has rapidly decreased since 1864, although it has been proved that superior flax can be grown in Ireland and the United Kingdom if the crop is made profitable for the farmers and they are properly assisted in getting the best results. Mr. F. K. Jackson, Director of the Flax Experimental Station at Selby, says in regard to flax:—"One of the most striking results has been given with some seed which has been selected for length of straw by Professor Bateson, of the John Innes Horticultural Institute, and sent to me for trial." For two years the straw has grown at least nine inches longer than that from imported Dutch seed alongside of it.

Dr. J. V. E and Pure Str of Seed

This is one of the directions in which research can produce the most important and immediate results. Dr. J. V. Eyre, in his recent lecture before the linen trade, showed what can be done in producing pure strains of seed, both from the point of view of length and plant perfection and also from the point of view of uniformity and quantity of the fibre produced.

Importan of Resea starting at the beginning

This means that research should start in your case from the very beginning, at the production of your raw material, and that the farmer as well as the other units of the "linen industry" can benefit tremendously by the application of scientific knowledge to his methods of growing a flax crop.

The flaxseed can without the slightest shadow of doubt be selected year after year until a plant of uniform proportion can be obtained.

The fibre produced from the pure strain, as explained by Dr. Eyre, is quite remarkable, and when we have this in commercial quantity we may look for a larger yield per acre and a more even quality of flax.

In producing a pure strain on the Mendelian system a period of four years at least is necessary before the strain becomes constant, and not till then is it possible to commence growing the flax for quantity production of seed.

The first stage in this research has been to produce a long-stalked plant without the tendency to branch; the subsequent stages will be further improvement in quantity and quality of fibre and the isolation of particular types for specific purposes.

Anyone who knows anything about flax-growing is aware that every beet of flax is composed of long stalks, short stalks, thin and thick stalks, stalks that branch—in fact, every variety. Think what it will mean when your farmers are using a pure strain of seed which will produce a longer flax with greater yield, level in height, and uniform in quality throughout!

It is quite conceivable that in the future it may be possible to increase the yield of flax per acre by 75 to possibly 100 per cent., and thus secure a more economical production of your raw material.

Neglect of the Flax Crop

No agricultural crop has been so neglected as flax. There are pure strains of potatoes, turnips, wheat,

oats, apples, oranges, walnuts, which have been developed scientifically to suit varying conditions of climate, soil, and market; in all these instances quality and yield have been vastly improved.

I have heard much talk about the necessity of producing "cheap linen," but would it not be a better policy to endeavour to produce "good linen" more economically from an improved strain of flax rather than to make low quality from poor material? In this endeavour research can help enormously.

I am informed that Russian flax, generally speaking, is coarse and irregular. The Russian flax districts are now penetrated by Germany; and even if we win as complete a victory as we hope for, you cannot expect to eliminate the German commercial influence. You cannot afford to leave yourselves in the dangerous position of depending on such an uncertain source for your main supply of raw material. The modern tendency in industry is to control that supply. You have now the opportunity of developing your own good home-grown flax, and by science and organisation inducing such economical production that, while surpassing in quality, you will also be unassailable in price and value throughout the markets of the world.

When three pure strains of seed come on the market every farmer should be encouraged to use them, aiming at the production of a given quality of fibre, which if scientifically handled in the subsequent intermediate processes would lead to the solution of

many difficulties which at present confront the spinner and the manufacturer. More scientific knowledge of the saving of flaxseed is undoubtedly another field for research, so that perfect seed and uninjured fibre may be the grower's reward for his labour.

No farmer who has any imagination would rest satisfied with the yield of 31½ stone per statute acre (which was the average Irish yield for the last ten years). If shown the way to obtain an increase he would gladly co-operate with the other members of the linen industry in undertaking the research of problems which are primarily his own, but also in reality the problems of those who pick up the threads where he lays them down.

Advantages of Co-operative Retteries

One could hardly over-estimate the possibilities of the introduction and development of a system whereby the flax would be bought on foot from the farmer and subsequently handled by scientific methods in co-operative retteries. In this way the farmer would be relieved of a responsibility which never should have fallen upon him, and would then be able to direct his energy and skill to the production of a larger and better crop.

I am told 400,000 acres would meet the present requirements of the linen trade, and that this could easily be grown by your farmers if freed from the intolerable burden of pulling, retting, and subsequent operations.

STUPENDOUS COST OF WASTE TO THE INDUSTRY.

Low Cost of Production

PRIOR to the war everything was cheap, wages were low, and flax cost a fraction of what it does to-day, and we shall never again return to the old low level of values. Linen is the strongest and the most beautiful among vegetable fibres, and but for its price nothing could compete with it. Everything is in its favour except its comparatively high cost of production.

High Cost of Production

It is obvious, therefore, that the linen industry should concentrate on this "high cost of production" and see what can be done to reduce it.

I do not suggest making cheap linens out of the lowest-class fibre obtainable—quite the reverse. In order to serve the public best you need to give them value—not mere cheapness.

"Value" is made up of three elements—"quality, usefulness, and price." The worship of mere "cheapness" is suicidal; it is usually accompanied by price-cutting, and has bled many an industry white. Some sections of your industry, I am informed, have suffered from this in the past.

Waste

It is, therefore, the high cost of production in particular you want to get after. Waste is one of the chief factors in high cost of producing, and one of the principal functions of research is the "elimination of waste."

Strength, quality, and lustre are what you require in your linens. Your own good home-grown flax is rich in these properties; the coarser Russian flax, on the other hand, is deficient.

Shipping will be scarce and freights high for several years after the war, and will not Germany control commercially the Russian flax districts?

It would be dangerous to allow your industry to depend on this source for its main supply of raw material.

You are all agreed now, I am sure, on the value of encouraging home-grown flax from selected seeds. In this you have everything to gain, and your Research Department will help you enormously, both in the matter of reducing the cost of production and also in still further improving the quality and uniformity of the fibre.

Waste in Growing

Dr. Eyre has shown us very clearly in his recent lecture the great future that lies in the production and refinement of pure strains of seed, as dealt with under "Science and Flax Cultivation."

His experiments have reached a point where it is possible to say that a largely-increased yield can be obtained, with a definite gain in quality; he also leads us to expect that eventually quality can be controlled.

The first step forward has been brought by scientific research. It took a period of over five years to reach this point, and incidentally I would suggest you make a mental note of the time involved.

That research on flaxseed will eventually reduce the cost of fibre production considerably has been clearly foreshadowed, yet this is only the first in the many processes which go to make up the linen industry.

Waste in Seed

In addition to the unnecessarily low yield per acre, which is quite preventable, the first great source of waste is the destruction of the flaxseed, which would, I am informed on the best authority, be equivalent on last year's acreage to £500,000 sterling at crushing price. There is also the waste of the bolls, which are used in Belgium and Holland for feeding purposes.

Waste in Pulling

Every farmer knows the enormous expense entailed in the pulling of flax, not to speak of the loss in yield which may result from careless work. I understand there may be several stones per acre saved in good pulling. Experiments in mechanical pulling have been made during the last year or two with increasing success, and when this machinery is perfected an enormous saving will be effected in cost and yield.

Waste in Retting

This process has proceeded on more or less the same principles for 4,000 years, and has never yet been systematically researched. Retting is a bacterial process, and therefore lends itself to scientific treatment, and it is not unreasonable to expect, as in the case of the seed, a similar new world of opportunity will reveal itself once this problem has been scientifically tackled.

We know vaguely that a great deal depends on the

retting, and that this process to a considerable extent governs the yield in scutching, the spinning and bleaching properties, the lustre and character of the flax; yet few attempts have ever been made to get it under scientific control.

It will surely be worth considerable expense, time, and trouble to thoroughly research this most important process, and one would be safe in prophesying that improved quality and reduced cost would be the result.

Upon investigation I find that flax as it is brought to the scutch mill is, as a rule, tossed and either over or under retted, each of which entails considerable loss of valuable fibre; but on this subject no one seems to be able to give me the definite data on which to base an estimated loss.

Waste in Scutching

The scutching process comes next in order, and from the information and data at my disposal the deliveries of Irish fibre of the last season's crop are almost exactly in the proportion of two parts scutched flax to one part rescutched tow; one-third of your good flax has therefore been broken up into tow. It also seems that the loss does not end here, and that a considerable quantity of fibre is thrown away with the shive, so crude are the retting and scutching processes.

Careful experiments have been made, and it is estimated that, on this season's crop, 3,500 tons of fibre will be thrown away, and probably burned.

As scutched flax this fibre would be worth almost £1,000,000.

I have gone into the figures for the 1918 crop, based on 150,000 acres, and taking an estimated yield of 30,000 tons of flax and 15,000 tons of tow at the average prices of £280 per ton (35s. per stone) for flax, and £85 per ton for tow:—

Scutched flax,	30,000 tons at £280 ..	£8,400,000
Rescutched Tow,	15,000 tons at £85 ..	1,275,000
Lost with Shive,	3,500 tons ..	..
		£9,675,000

Now, had this process been systematically researched, the retting been improved, and machinery devised to give you all your fibre as scutched flax, eliminating all the scutching tow, the figures would read:—

Scutched flax, 48,500 tons at £280 .. £13,580,000

This indicates a gross waste of approximately £4,000,000 on the 1918 crop. The loss which is made apparent here is absolutely appalling. Eliminate it by only 50 per cent. and you are at once removing a crushing handicap from the industry. What possibilities lie here for reducing the cost of linen, improving the quality, and increasing its sale!

But 30,000 tons is not one-third of your normal requirements; so that were you to grow, say, two-thirds of your fibre in Ireland the reductions in cost

would be enormous, amounting to somewhere around 20 per cent. on the finished cost of your linen.

We have dealt in this article only with the waste in the preliminary processes; the waste in spinning, I understand, is almost as large; and while the percentage of waste made in the subsequent processes is a gradually diminishing one, it is the waste of a material increasing in value with every process.

It seems to me as an outsider that it is the waste due to unscientific retting and scutching which is mainly responsible for the high cost of linen, and that were these processes improved you would be in a position to compete in price with cotton.

The vast possibilities which this would open up for the linen trade must surely justify a large expenditure on immediate scientific investigation; indeed, it is one of those problems which might well be put before a man like Edison. The man who invented the "talking-machine" could solve your flax problem.

Again, from the outside point of view, I cannot help remarking that along these lines lies the future prosperity of the linen trade.

It was your own beautiful flax that made your linens celebrated in the past, but before the war flax-growing had almost become a lost industry to Ireland. Revive it, nourish it by systematic, thorough research with scientific control, improve its quality and reduce its cost of production; then you

will place yourselves in a position unassailable in the linen markets of the world.

I am not surprised, however, that these problems, glaring though they be, have never yet been taken up. It was too big a problem for individualistic treatment—the risk was too great. But you are now an organised industry, beginning to appreciate the big things a combined trade can carry out co-operatively, at small financial risk to the individual firm.

But waste does not end here; your marketing methods also require the application of scientific research. There is preventable waste evident there as well as in the wasteful scutching process.

Selling also can be carried out on scientific lines, nourished, stimulated and increased.

AIMS AND IDEALS OF THE RESEARCH ASSOCIATION.

AN ancient writer says: "Where there is no vision the people perish." This thought embodies not only the power of foresight and imagination, but the power to comprehend our faults and failures of the present, which is the first step towards progress.

Owing to the keen race for life the majority of people have their time so fully occupied that there is little inclination to study the pros and cons of the daily routine.

To the more thoughtful the "whys" and "wherefores" do occasionally present problems, but the want of time and opportunity often raises barriers that are insurmountable; therefore many valuable and brilliant thoughts are lost to the world. Had the linen trade a research department these thoughts could be put before a staff scientifically trained whose minds were free from the ruts of commercial routine, and thus they might form the basis for investigation of great value to the trade. This is what the Association aims at by putting this opportunity for investigation within the reach of all.

It is therefore with considerable interest I give the thoughts and suggestions of a member of the linen trade upon the research and standardisation of yarns and weaving.

Standardisation of Yarns and Weaving

"Owing to a gradual but unscientific growth of the linen trade, different qualities of yarns have become very numerous in the market. This is no doubt owing to demand from two distinct schools of thought and practice in the weaving section of the linen trade—namely, those who advocate low-speed looms with a low and weak type of warp, and those who believe in using a higher quality and stronger yarn with an increased speed of loom. These two classes of manufacturers are competing keenly with each other, and consequently there have been great differences in the price and costing of goods which causes unnecessary competition.

"Should a standard system of costing be adopted —which seems a reasonable proposal—it would necessitate a standard and uniform speed for each of the different widths of looms, and this would develop standard spins of yarns which would enable the manufacturer to determine more definitely and more scientifically the best and most useful standard of yarn required for weaving purposes. At present yarns are spun almost entirely in accordance with the individual views of the individual spinner without his knowing the precise requirements of the manufacturer; therefore manufacturers have to select from the various qualities the most suitable yarn which they can find for their purpose, and there is no co-ordination between the manufacturer and spinner to produce yarns of the most suitable type for the manufacturers' requirements.

"Owing to this lack of knowledge and co-ordination even spinners' own standard marks vary considerably, just as they find difficulties or otherwise in getting the precise quality of flax from season to season, and have therefore to alter the spinning processes to get the standard of strength needful to make the yarn required, without that due regard necessary to the elasticity and weaving properties.

"If the foregoing assumptions be correct, the standardisation of both weaving and spinning is a subject that requires careful examination and definite knowledge, so that spinners could concentrate their expert efforts in producing the best possible weaving yarns in each quality and number, and manufacturers should build their cloths so as to produce the best effect and finish.

"With fixed standard yarns the sizing of warps could be more scientifically pursued, and starches and other mixes could be arrived at which would give the best weaving properties, possibly reduce the sizing bill, probably lessen the humidity of the atmosphere in the weaving shop, and thereby improve conditions under which the workers labour. This of course presupposes a certain degree of standardisation in the flax produced.

"Uniformity in these important matters would also help to bring about a standardisation of wages which would be fair and equitable to all.

"Having scientifically controlled the details required

for the production of linen goods, the research could be carried further, and the whole question of standard cloths should be reconsidered and rebuilt on such lines as would best suit the finish and purpose for which these goods are intended. It is well known by bleachers that some manufacturers' goods are more easily finished than others, and therefore their goods are always better in appearance and handle owing to the finish being arrived at by the first trial or intention, as subsequent treatment invariably reduces the appearance and destroys the handle and lustre. But owing to the divisions of the expert processes many difficulties remain mysteries, which could be elucidated if only it were possible for one individual to possess the necessary knowledge to control scientifically the whole system and process, from the selection of the flaxseed to the bleaching and finishing of the goods. As this is impossible it has rendered more necessary a thorough research in the different departments so that the knowledge acquired should become the common property of the trade, which even if only theoretically understood would tend to raise the standard of quality, style, appearance, and lustre, and so enhance if possible the beauty of texture and appearance which makes high-class linen goods so much appreciated and valued.

"Merchants and others should therefore have a theoretical knowledge of the kindred branches of

their trade, which can be acquired, by the younger members of the trade at any rate, through a course of study in our technical schools. This would enable them to discuss and describe their requirements to the various experts with whom they do business, as well as being in a position to appreciate the requirements of their customers in the world's markets, and so attain a still higher position for our staple trade throughout the world."

All the above questions depend largely on chemistry, and it is important that chemical research be developed as it affects the various operations. The sizing of the warps is universally based on the use of starch in one or other of its forms, but practically nothing is known of the chemistry of starch and the reasons why one form is more suitable than another for a particular purpose.

It is important to have a complete knowledge of starches and their relations to one another, and of their action under varying conditions. Such knowledge would be of great value to the manufacturer.

Then, again, the bleacher, dyer, and finisher not only needs a knowledge of sizing materials but of other chemical substances used for imparting specific characteristics to the fabric before it goes to the market. Only laboratory tests as to the bleaching of yarns will prove whether this might not be an advantage to the manufacturer.

It should be possible to discover a process of

treating the yarns so that they would not readily crease when woven. There is a growing demand in the States for dress linens and suitings which do not crease. Will it ever be possible to discover a process for treating the yarns so that the linen when woven would be free from creasing? This would be a great advantage in the use of linen for dress materials, and a tremendously increased demand for such goods would thereby immediately ensue.

The spinners' and growers' interests are identical, and there should be no real antagonism between them. They approach the problems from different angles: that is all. The grower thinks of the value of his crop. The spinner is interested more in the quality of the flax which will give him best spinning results. Different kinds of material and different ways of finishing require different classes of flax fibre. The trouble is to say exactly in what way they differ. Only research can provide a language comprehensible to both.

NEED FOR A NEW OUTLOOK.

A CENTURY ago all British industries held a commanding position in the world. This created a deeply-rooted feeling of security among most British manufacturers, which together with a natural conservatism has acted against the ready adoption of new proposals which called for investment to develop along new and original lines, either in methods of marketing or in production of the goods. This is especially true where the immediate financial returns are not positively assured. Aside from this, many of the heads of British industries have not been educated in a manner which gives them a keen appreciation of scientific knowledge.

Staff Training

I would suggest that every concern of any importance should select from its staff one of their younger men possessing sufficient preparatory education, known loyalty and ambition, who could be given a special science course in the Technical Institute. This man would become the contact point between his concern and the Research Department, he could understand the common language of science, and take up and apply the discoveries and suggestions of the laboratory.

Even without a research department such a man would be valuable in a concern. There would be enough to do to more than earn his salt. There are

the gases, oils, coal, etc., which, if analysed constantly, can be made to produce greater efficiency. There is the testing of water and watching the spinning troughs, by which he will be able to improve the bleaching properties of the yarn. By close analysis of all supplies he will save his concern money. One linen manufacturer saved £2,000 on his coal bill by watching the draughts and gases in their furnaces. He could also save his concern money in minor ways, as, for instance, the elimination of troublesome stains.

A Paying Proposition

Scientific research is a paying proposition, for it attacks the problems most pressing to the trade which arise in the course of ordinary routine—problems which ought no doubt to be solved by means of their own scientific staffs, but are not solved, as few have men trained for such work or laboratories equipped to carry out the experiments.

If from no other motive the linen trade should look upon efficiency as a weapon against the competition that awaits them in the future.

Those who have followed the papers know that the German Government has not been asleep in its preparation for activities after the war. Early in the war she formed a Board of industrial magnates, which has been operating ever since, with the whole power of the State and the German banks behind it, acquiring huge quantities of raw materials in South America and elsewhere ready to ship immediately

peace is declared. As they have provided for raw materials, so they have for their producing and selling organisations. You may depend on it every available opportunity will be taken to get ahead of British goods in the markets of the world. To ignore that fact and continue in the belief that conditions will after the war adjust themselves as before is playing into Germany's hands.

You may have held the premier position in the linen markets of the world; but even as a preponderance of man power and of wealth will not bring victory against superior directing power and organisation, so your supposedly safe position will not secure your pre-eminence if you neglect any of the means for advancing the efficiency of the industry by research or neglect your markets.

Thoughtful men of business who have tested it out will tell you that directly scientific knowledge is applied to the problems of production and organisation, so surely are all previous estimates of possible earnings outdistanced to such a degree as would seem fabulous to the uninstructed mind.

Many industries in the United States came to the realisation years ago that it was the systematic application of science which has played for the rapid progress of German trade.

America and Research

During the past twenty years large American companies have been setting up their own research

laboratories, so as to keep the lead in their respective lines.

Freedom of Action for Laboratory Staff.

The research laboratory would formulate the underlying theories of the entire industry, It would need to be elaborately equipped and a proper staff employed, **with a thorough understanding at the outset that they were to be absolutely free from outside pressure or annoyance, and that they would not be subject to destructive criticism even if their work were unremunerative for several years.** It must be understood that for a considerable time after its foundation no extraordinary results may be expected by the industry.

A member of the Provisional Committee told me that the linen trade work with a balance sheet in one hand and a knife in the other, and if at the end of six months a department does not pay it is cut off.

For ten years the Champion Spark Plug Co., of Toledo, Ohio, kept up unremitting laboratory work on spark plug porcelains, experimenting with thousands of different combinations and mixtures in their laboratory furnaces; day after day various formulas were conceived, tested out, and carefully recorded. During the period of ten years new developments in petrol motors increased the severity of the requirement; 3,449 different combinations failed until the 3,450 porcelain was produced, 100 per cent. perfect, of undreamed-of qualities, and

so distinctively in a class by itself that it is known to-day by the trade name of Champion No. 3,450.

Mill Dust and Beeswax

You collect a great deal of dust by the ventilating parts of your mill, and then you either blow it away and pollute the atmosphere or you have considerable difficulty in disposing of it. So far this dust has been an unmitigated nuisance, and yet in this dust you are throwing away probably £400 a week. Scientific research, not conducted on behalf of the linen trade, has demonstrated that 10 per cent. of this dust is a wax almost identical with beeswax, and those responsible for this work will be prepared to hand over the required results to be worked out by industrial research. Why should not the linen trade get this department of industrial research going, and so test out the possibility of eliminating this source of trouble and transforming it into a source of revenue?

In the linen industry, as in every other, progress is the result of continual acquisition and application of new knowledge. In a competitive market progress is indispensable to success. Competitors, therefore, are successful according to the extent to which they are able to usefully employ new knowledge as compared with their less progressive rivals.

After the war you will require to compete as an industry, and not with one another.

A Trade Library

In the contemplation of research for the Linen Association it will be important first of all to

ascertain what scientific work has already been accomplished in similar trades elsewhere. This necessitates a varied collection of scientific data. You would need (and it would be an important part of your laboratory) to have extensive library facilities, of text-books, authoritative reports, current scientific magazines, and scientific literature.

You would need also to educate your own industry along advanced lines of thought, to encourage an interchange of ideas and discoveries in and out of the linen trade, which could be done by means of a monthly industrial organ for the linen trade that would discuss and report findings of the department, and give a digest of current scientific news bearing on the production and distribution of your own and competitive trades, etc.

Probably because the trade is not at present sufficiently appreciative of the need of scientific knowledge, this suggestion may be thought useless. However, much valuable information which would be available could not be utilised without the industrial organ. Indeed this industrial organ, outside the question of the research department, will be a necessity in your trade now that you have become organised.

The democratic grouping together in industries has been going on in America for some time, and one of the greatest difficulties they have had to contend with was that their councils or committees

were always possessed, or supposed to be possessed, of information not known to the rank and file. It has, therefore, been found necessary to methodically supply information concerning the business transacted at these meetings to the ordinary members, otherwise sooner or later there was trouble due to uninformed gossip and inaccurate rumours.

Where any mystery existed, it was found that the ordinary members were dissatisfied, and were convinced they were being run by a clique. It is a psychological question, but psychology is a scientific force that cannot be ignored with impunity. You have either to give away a certain amount of information or else break up the harmonious working of your associations.

The former is the lesser evil, and it is only by means of an industrial organ that information can be methodically supplied to the trade.

Free Interchange of Ideas

The California Fruit Growers' Association—the most successful grouped industry in America—is so particular on this point, and also that the cards should should always be played face upwards on the table, that not only does it circulate all information to its members and open its books for their inspection at any time, but at all meetings of the directors it is free for ordinary members to come into the room whenever they please and hear how their business is being transacted.

It is important that all the results from investi-

gation should be given to flax-growers, and that the farmers be assisted and encouraged to grow better qualities.

You have in your community those who have been experimenting for a number of years in the use of seed specially selected from picked stalks of flax. The remarkable results produced by seed selection, as shown in the recent illustrated address of Dr. J. V. Eyre, M.A., Ph.d., should be published for the benefit of the whole trade.

It is not the one lecture, the one article, the one number of an industrial organ, or the one advertisement that does the work. The value comes in the cumulative effect of getting people to think along new lines; little by little their ideas change, their outlook broadens, and they move forward.

Efficiency is a matter of comparison, and comparison of industrial production per wage-earner per year in the U.S.A. and the United Kingdom shows that in most cases production per head is from two to three times greater in the States than it is here, where they are less efficient. In the production of cotton goods, which is fairly efficient in England, the difference is only 40 per cent. greater in the States than in England.

Greater Employment of Machinery

In the cotton industry, for instance, in which the American worker produces 40 per cent. more per year than the British worker, there is 2,214 horse-power per 1,000 workers in the United Kingdom,

and 3,423 horse-power in the United States. A superiority of 40 per cent. in American production is accompanied by a superiority of about 60 per cent. in horse-power.

The explanation of the curious phenomenon that American workers produce as a whole from two to three times as much per year as do British workers engaged in the same industries is very simple. It is due to greater employment of machinery, greater mechanical efficiency, and by a more intensive use of science.

WASTE IN MARKETING LINEN.

A SERIES of shocks sometimes do a wondrous amount of good. If this article produces another shock, it will have served its purpose.

It is not fully realised that industrial conditions have changed, and that many of those which originally enabled British industries to assume a premier position no longer exist. The position of an industry is determined not so much by the capacity of its manufacturers as by their performance. It must not be forgotten that priority achieved by those who carry out pioneer work yields a most important advantage. In the previous articles some appalling wastes of raw material as it passes through the different processes was dealt with.

Waste no Confined Raw Material.

Some may feel annoyed at such a ruthless exposure of the waste that is going on daily in their industry, but they should rather rejoice that such great possibilities exist for improvements and economies, and resolutely determine that they will have a complete and efficiently staffed Department of Research in the Linen Industry in order that a start may be made as soon as possible in the elimination of these crushing burdens. But there is another "process" in your industry where waste is even greater and more costly, if coming under a different description, than in those already dealt with. I refer to "marketing," and under this head it is correct

to bracket the functions, "buying, selling, and distribution." Just as in manufacturing, so in marketing, you may develop either along "hit or miss" or along scientific lines. In an old industry like yours, where individualism and keen competition have existed for many years, the methods are almost sure to be unscientific.

German and American Scientific Methods

German industries and the larger concerns in America research their markets, their selling methods, and policies just as systematically and scientifically as they do their processes of manufacture. Nothing is left to chance; skilled investigators working on scientific lines are all the time researching in this field—guiding the sales department with their expert knowledge, preventing them getting into ruts, and keeping them up to date—planning and arranging for the scientific distribution of the merchandise to the best advantage, advising as to new lines and uses, and keeping the production department right as to quantity, quality, and variety of output.

Effect of Market Research

Scientific market research was my profession when living in the States. I was in charge of this department in Messrs. Butler Brothers, of Chicago, the largest merchandise house in America. It was organised according to the most scientific and up-to-date practice. It was started in 1877 with a capital of £200, but so rapidly has it grown that the annual turnover is now over £15,000,000, actually

larger than the net pre-war output of the whole Linen Trade.

Every one of the heads of the business was obliged to keep in touch with the latest methods introduced by our Research Department.

The country was organised for scientific distribution into five areas, each having its warehouse where stock was carried for that area.

The Market Research Department was located at headquarters in Chicago.

Our investigators, numbering over 100, were always on the move, travelling every State in the Union, and the American Possessions, researching the markets. Their reports came to headquarters, were there sorted, and assembled in graphic form, making a complete and continuous up-to-date source of information for the guidance of the management.

For the purposes of this research every State was analysed geographically, and was sub-divided into counties, cities, towns, and hamlets. These in turn were analysed on a population basis, and we figured the amount of business we ought to get from each. We were determined to get that amount of business, and we got it. We concentrated for a fixed period on those places which were not putting through the amount of bnsiness they owed us, and if at the end of that time we did not get it, our Location Department planted a store.

We employed no commercial travellers, and our investigators were not permitted to accept an order; all our selling was carried through by means of comprehensive advertising campaigns, with catalogues and sampling.

Our sales expense, including the advertising, averaged 2 per cent. on the turnover, whereas ordinary wholesale selling cost usually exceeds 10 per cent.

From personal experience I can assure you that the economies that can be effected, the smooth and rapid way in which a business can expand working with scientific knowledge along scientific lines, is almost incredible.

'Distribution' Neglected in the Past.

The question of "distribution" does not appear to have received the attention that it requires. Manufacturing has, as a matter of fact, developed ahead of selling, distribution, and finance, because the latter functions are not so obvious and have not attracted the same concentration of thought. To this weak spot is due the evil of "restriction of output" by the trade unions, and this policy, owing to the existing methods of selling and distribution, is not so illogical as some people think.

Selling Cost Exceeds Cost of Manufacture

No one who does not carefully analyse the problem can realise the high cost of marketing, of buying, selling, and distribution. Indeed, in almost every instance the cumulative cost of these three

items exceeds the actual cost of manufacturing. Did you ever realise this?

Let us analyse the past history of your own industry from this particular point of view. The farmer in Russia or Holland sold the seed to the merchant there—he in turn sold it to the wholesaler in Belfast, who sold it to the retail seedsman, who sold it to the growers in Ireland. It's like "the house that Jack built."

Here are four sales and four movements, each carrying a profit and the cost of movement, interest, overhead charges, accounting, &c., before the seed ever reaches the ground.

The Irish farmer may sell to the flax merchant, the flax merchant to the spinner, the spinner to the commission house, the commission house to the weaver, the weaver to the merchant, the merchant to the wholesaler, the wholesaler to the retailer, and the retailer to the public, the ultimate consumer. Altogether there are twelve different sales, accompanied by movement, before the merchandise ever reaches the ultimate consumer. All sales and movements cost money; they total an enormous sum. They may all be necessary, but it is well to know about them, and the problem is well worth researching.

What I particularly wish to deal with, however, are the last two of the series—"the marketing of

the finished goods," for it is here my personal experience chiefly lies.

American Linen Market Analysed.

Let us again analyse the pre-war conditions in your industry from this point of view, taking the United States for our field. This was your largest market, and was centralised in New York. Practically every merchanting concern had in this centre its own house, or else worked through an agency. The Linen Colony was located down town as far away as it could get from the neighbourhood of the hotels, railway centres, and large New York stores. In this unfavourable location a form of civil war was carried on among the members of the trade; they were so intent on getting the better of each other that they had almost lost sight of the main factor in the situation—the reason for their existence—which was to produce and distribute linen in the most efficient and economical manner, They were all centred in New York, overworking this district, and underworking the balance of the country. Many carried stocks; and owing to the division of the industry into so many small units or firms, the overlapping in stocks of each particular class is bound to have been considerable and far in excess of the amount necessary for the volume of trade the industry was doing. This means waste to the industry as a whole—not alone in the extra cost of carrying stock, but also in the interest on the capital involved. Here would be found a large

waste if it were possible to obtain the necessary data.

There is another waste that is bound to exist in a highly divided industry, in that it is impossible to gauge market requirements. You would be in a perpetual condition of having too much of one thing and too little of another—the former means an expensive carry over, the latter lost sales. It is impossible to obtain figures to arrive at an estimate on this, but anyone can realise that the loss to the industry as a whole must be considerable, and the working capital necessary to finance is excessive.

Waste in over-keen Competition

There are other wastes caused by over-keen competitive selling in addition to the very obvious one of "dissipated profits." Every house of any size tries to carry something of everything, and in addition the ranges become unduly multiplied in each variety in trying to get behind the other fellow. This means carrying much larger, more unwieldy stocks than are really essential, and the unnecessary variety makes manufacturing more expensive, besides holding up so much capital. Furthermore, the wholesalers you sell to are competing among themselves; they are also playing you one against the other, and the quality of the linen consequently gets needlessly beaten down with the price, for the working expenses on "cheap goods" are just as much as on quality goods, and your

profits are usually based on a percentage on the turn-over.

Those who possess analytical minds will therefore clearly see that scientific organisation and distribution will eliminate these unnecessary expenses, and at the same time will provide better value for the public whom you serve. This will add greatly to the status of your industry.

In this article I have been analysing the existing methods of marketing in the Linen Industry. With my experience in researching the American markets I may be permitted in the next article to suggest some improvements, where they occur to me.

SUGGESTIONS FOR A SCIENTIFIC MARKETING POLICY.

IN the last article, "Waste in Marketing," the pre-war system in the Linen Industry was analysed.

Methods of Selling and Distribution in Linen Trade are Wasteful.

The conclusions that one cannot help drawing from this analysis are that your selling and distribution lack point and method, and are the reverse of scientific—consequently there have existed considerable wastes of long standing which have acted detrimentally to the prosperity of everyone concerned in the trade. This is no reflection on the individual ability of the members of the industry, which is of a high order. It is the system, or rather the lack of system, that is at fault. You require a "definite selling policy" if your sales are to expand, but hitherto, owing to the individualistic nature of the industry, you have had no policy at all.

Definite Policy Required

If you are to successfully meet competition under the changed order of things after the war you must have a "policy," and in framing this policy you will require to look years ahead, for to continue it to a few years after the war, only, would be fatal.

The full force of the competition which is developing will not be felt for several years, and if you wait till then it will be "too late."

Germany is aiming at a large export trade which will compete against you with all the force of a combined scientifically organised industry. Japan is steadily developing a linen trade. Indeed, I am informed that there are Japanese students studying in your Technical College here. I spent some time researching the markets and commercial system in Japan a few years ago, and would warn you that competition from this quarter is not to be despised, as their methods are advanced and scientific. What you require is a strong, far-seeing policy. You yourselves, alone, can frame this policy, and it is only for me to point out its importance and make a few suggestions.

Example of an Industry with highly Developed Policy.

I can best convey what I mean by describing the sales policy of an industry which is famous over the world for the way it has handled this particular problem. It is the California Fruit Growers' Association. You have heard of it before, but its sales methods will repay close analysis and study. Mr. Hamilton Wickes, the Board of Trade expert on commercial matters, referred to it when he was in Belfast recently, as a pattern that any industry might profitably follow. This industry was even more finely divided than yours—the cost of marketing its product was enormous, and the individual growers were at the mercy of the wholesalers, just as you have been. Everything was carried out in an individualistic and unscientific way, from growing the fruit to selling

the product. Waste was rampant, and the quality of the fruit under these conditions had fallen to a low ebb. The orange crop was greater than the demand. There was no co-ordination ; one market would have a glut, while another was experiencing a famine.

The fruit distribution was handled from one centre by a number of competing wholesalers, this unscientific method being, of course, wasteful in the extreme, and entirely inadequate for a country as large as the United States. The growers first tried an association for fixing minimum prices, but though this for a time improved matters, it had no effect in remedying faulty, wasteful distribution, which seems to me to be a weak spot in the Linen Trade also.

They analysed the problem carefully, and came to the conclusion that the only cure was to act together co-operatively as their own wholesalers, and to organise the country for scientific distribution. The result was the California Fruit Growers' Exchange, which handled all the fruit for the Association. The country was divided into seven areas, each area having its own headquarters, where stocks were held, and from where they were distributed. Scientific market investigators were employed, and the country was subjected to a continuous research, so that the Board of Management in Los Angeles had accurate information, and were able to replenish the stocks at the seven headquarters in just the correct quantity and proportion.

Before the Exchange was formed selling costs amounted to between 7 and 10 per cent., whereas in 1917 they amounted to only $1\frac{2}{3}$ per cent.

Advertising Essential to Scientific Selling.

A selling organisation as scientific as this, of course, quickly developed in other directions—their combined advertising campaign, which has increased their turnover 81 per cent., being one of these developments, and this is run on most scientific lines. Last year, with a turnover of £12,000,000, they spent £80,000 on advertising—·85 of 1 per cent. on their turnover.

Mr. G. Harold Powell, their expert manager, states that this small percentage expended co-operatively brings as great a return as would 10 per cent. expended individually by each grower. In advertising, as in other things, it is the weight, the concentration, that spells results. This industry affords an interesting object lesson in how scientifically organised industry can plan ahead for its future expansion.

Scientific Industry can Regulate Sales and Expansion.

An unscientific industry waits till there is a suction in demand—in other words, a wave of good trade—when it hurriedly rushes up buildings and orders in machinery at break-neck speed. When the buildings are completed, and the machinery ready, oftener than not the wave of good trade has passed.

The orange growers plan their trade expansion years ahead. By means of their scientific market investigations and records they know what the normal expansion due to selling a genuine commodity will

be ; they know also from their carefully kept statistics what additional sales they may count on from a specified amount spent on advertising, and they know exactly what additional acreage in orange trees it is possible for their Association to conveniently handle, and they arrange accordingly.

With this scientific knowledge to work on it becomes possible to lay their plans for several years ahead with confidence and accuracy, and to make their preparations in harmony with those plans. You can control an industry organised on scientific lines, otherwise the industry controls you.

In 1916 changes due to the war threatened to upset their arrangements. Exports were restricted, but to meet this crisis they increased their advertising appropriation to the figure necessary to force their own country to consume the whole crop, which it did.

This year a large additional acreage will come into bearing, some of which was intended for export, but it has been arranged that advertising will take care of it, and the industry continues quietly and confidently on its way without panic or fears for the future,

Another general development has been that the industry has introduced science and scientific method throughout its whole fabrics, and the orange growers have made high profits without increasing the cost

to the consumers. I understand that a pamphlet is being printed for distribution to the members of the Linen Trade, giving the history of this unique and interesting industry, with the Annual Reports for 1917 of their Exchange and Co-operative Supply Association.

Though industries differ in detail, the underlying principles are the same for all, and I would recommend the Linen Trade to carefully study this pamphlet, as it affords an excellent pattern for other industries to follow, of course adapting the details to their own particular needs.

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To return to your own industry. It would take time to organise it in its entirety to this pattern, but there are some clearly defined, more or less standardised sections, such as the Cambric and the Canvas Holland and Buckram Associations, which could with little trouble and with great profit to themselves adopt this principle in their selling and distribution. Great benefit would result from the thorough working of the whole country with the scientific handling of stocks and economical distribution.

All these articles have been suggesting an ideal for the scientific development of your industry. Everything cannot be done in a day, and all development is gradual if it is to be permanent. You cannot slate the house before the foundations are laid and the structure has reached the appropriate stage.

But whether it be the building of a house or the scientific rebuilding of an industry, you require in the first place a policy—a plan to work to—or otherwise you will drift, progress will be slow, and many mistakes will be made.

Science should be the Keynote of your Industry

Science touches your industry at every point. To get the best out of it your selling and the distribution of your merchandise must be just as scientific as your specialised machinery. If all industry were run on scientific lines throughout there would be no poverty, want, or labour troubles to-day. Science might well be described as the "best, easiest, and quickest way to the desirable things of life."

In conclusion, I would quote from the Report of the Committee on Commercial and Industrial Policy after the War. Referring to Linen, it states:—

> "The chief difficulties of the British industry have been due to 'over-production' resulting from internal competition, and it appears desirable that all sections of the trade should recognise the advantage to be derived from common action to meet foreign competition after the war."

Were I permitted to criticise this I would *alter the words "over-production" to "under-selling."*

You want a strong, aggressive sales policy. This

as it stands suggests that "restriction of output" is not peculiar to the trade unions only.

When hours have to be shortened and machinery stopped from lack of sales, the workers have a good right to ask, "Have you done everything possible to sell the product?"

SCIENCE AND EDUCATION.

THE amazing revelations made in regard to lack of science in the curriculum of the British Schools cause me to digress in order to deal with a subject which more than anything else has had its bearing on the psychology of British Industry and the nation at large.

In order that there shall be a reasonable chance of being able to maintain your "place in the sun" it is necessary, above all, that education should move with the times.

It is a long way back to the 18th century, when a sound education in classics was recognised as the "be-all" and "end-all" of a boy's upbringing. Science was then in its infancy. Throughout the 19th century it was advancing by leaps and bounds. In this 20th century we meet it at every turn—there is no getting out of its path. That this is the age of science there is no lack of evidence in the present war. If that is so, it is no less true that science will play a most important part in industries after the war.

This is the Age of Science.

If you would live up to the demands of the 20th century you must maintain the spirit of the 20th century—the true scientific spirit. It is necessary to appreciate the fact that advancement of scientific knowledge is really of paramount importance to the industries of the nation. Make no mistake on that

point. The nations which recognise this necessity will go forward; the nation which refuses to recognise it will be passed.

I have already said much of the attitude of British manufacturers towards science, that attitude which Mr. James H. Stirling described as a "sort of amused tolerance towards an applied science." I have endeavoured to discover the reasons for this attitude, and I believe I have found them.

As the nation's boys are trained, so the men will be afterwards. Train the nation for many generations along classical lines alone, and it is not surprising that the nation does not appreciate the value of science until Armageddon has engulfed it.

"Neglect of Science." Grave report by 150 leading Scientists

A very grave report was published in "The Times" of February 2nd, 1916, headed "The Neglect of Science," and was signed by one hundred and fifty of the greatest thinkers in the United Kingdom.

The report called attention to the checks and set-backs suffered by the nation since war began, because of lack of scientific knowledge. The opening paragraphs read: "With a full sense of responsibility, we submit the following memorandum on a subject which, we are convinced, requires *immediate attention, and drastic action.* It concerns the public interests, and the public alone can deal with it.

It is admitted on all sides that we have suffered checks since the war began, due directly as well as indirectly to a lack of knowledge on the part of our

legislators and administrative officials of what is called "science" or "physical science." By these terms we mean the ascertained facts and principles of mechanics, chemistry, physics, biology, geography, and geology. Not only are our highest Ministers of State ignorant of science, but the same defect has run through almost all the public departments of the Civil Service.

Lack of Scientific Knowledge among our Government Officials.

It is nearly universal in the House of Commons, and is shared by the general public, including *a large proportion* of those engaged in *industrial and commercial enterprise.* An important exception to this rule is furnished by the Navy and also by the Medical Service of the Army. In both these services success has been achieved by men who, while in no way inferior in courage, devotion, and self-sacrifice to their brethren elsewhere, have received a scientific training."

Sir Ray Lankester, in his speech before the "Neglect of Science" Committee, gave specific cases wherein Germany had benefited because of lack of general scientific knowledge in the British Ministry of that time.

The passing of cotton into Germany was permitted for a long time against the advice of the scientists, who knew well enough it was being used in the manufacture of explosives. There was also a curious ignorance and hesitation about stopping the admission

of fats and oils used in the production of nitro-glycerine.

An extraordinary ignorance was displayed in the development of munitions; the specifications were so complicated, and the carrying of them out called for such minute exactitude under the most rigid conditions, that delays of months were caused, at an expenditure of millions, that would have been saved had the persons in charge of this work had intelligent supervision.

Lord Montagu of Beaulieu warns the Government n 1900.

Lord Montagu of Beaulieu called the Government's attention in 1900 to the fact that there was not a single factory in Britain able to make acetone, and that not a single pound of high explosives could be made without it. We were dependent on Germany.

He brought it again to the attention of Lord Haldane, and finally, after four years, succeeded in getting a very small plant established, which he described as a toy factory. This must have died shortly afterwards, for Sir Ray Lankester stated that there was a distinct failure on the part of our arsenals for want of acetone; but eventually it was made by the aid of a Russian chemist of Manchester.

This is the sort of ignorance from which the country has suffered. The men responsible were politicians, but it is more amazing that the business men of the nation should have drifted into the first quarter of the 20th century hampered by obsolete and conservative ideas, while their foreign competitors

have thrown overboard the Jonah of classical tradition and have overcome the obstacles of the open sea with the oil of science.

Neglect of Science by our leading Universities

Looking further for the reason why the boys of the nation have not had their minds trained along advanced and original lines of thinking, I find that the examinations for entrance into Oxford and Cambridge, and for appointment into the Civil Service and the Army, are among the greatest determining factors in settling the kind of education given at your public schools. Natural science has been introduced as an optional subject for the Civil Service examinations, but matters are said to be so arranged that only one-fourth of the candidates offer themselves for examination in science. It does not pay them to do so, for in Latin and Greek alone (including ancient history) they can obtain 3,200 marks, while for science the maximum is 2,400 marks, and to obtain this total the student must take four distinct branches of science.

For entrance into Woolwich, science has within the last few years been made compulsory, but at Sandhurst it still remains optional. *This Military College is said to be the only one in Europe where science is not included in the curriculum.*

Success now, and in the difficult time of reconstruction after the war, depends largely on leaders and administrators who use scientific methods and have the scientific habit of mind. They must have

the knowledge and the habit of promptly applying known means to known ends. To trust to luck is a mark of dangerous complacency bred of ignorance.

The whole British system of education seems to be indifferent, not to say contemptuous, towards the importance of science. It would seem almost as if a determined endeavour were made to neglect the study, and play into the hands of the German Emperor. Who knows but that Britain's indifferent educational system is not the result of insidious German propaganda for the past forty years, to whose industrial advantage it was to see that the British nation remained dormant and self-satisfied, while they spied out the land and stole your secrets, which they developed for the benefit of the Fatherland?

Neglect of Science by our Public Schools.

At Oxford not one of the colleges is presided over by men of scientific training; at Cambridge but four. Of the thirty-five largest and best-known public schools, only *one* has a scientifically-trained headmaster; but fortunately this school—Oundle, in Northamptonshire—is, I am informed, as far ahead in this respect as the others are behind.

At Oxford, even to-day, little or no importance is attached to science, though you will find on the records of Magdalen College in 1840 that Dr. Daubeny agitated for the need of study and science, and for seventy-six years it has been agitated without result. *Seventy-six years!!!* Has the nation gone crazy?

Is not this a most illuminating illustration of the psychology of the nation to-day? Will not now the men of Britain demand that the Government bring about drastic reform in the scheme of examinations for all public services? After the war, is the nation to be allowed to slip back to its previous indifference to progress and competition, and let its boys dry-rot in the dead past?

The Right Honourable the Lord Rayleigh, O.M., in his address on this subject, said: "The ignorance that one meets, one might say in all classes of society on scientific matters, is truly deplorable. Many hardly seem to know that there is such a thing as science at all. When it comes to the majority of schoolboys, I think it is nothing less than an absurdity to talk about impressing them with the language and literature of the ancients."

Contemptuous Neglect of Science by the Nation

Lord Montague states: "I do not think the attitude of the nation towards science is one of dislike or hostility. It is one simply of contemptuous neglect. We can only remedy that by beginning to teach the youth in the country the use of science and *respect for science*, until they in their turn rise to the top, when our future rulers may possibly by that means have some slight acquaintance with the laws of nature—the laws of the air, the laws of the sea, and possibly a certain amount of knowledge of the laws which govern their own body."

While we admire and make use of the classics to

a certain extent, it must not be forgotten that for the many, whose lot it will be to carry on the commercial affairs of the nation, a sound general education, in which science must have a prominent place, is absolutely necessary.

THE SCIENTIFIC APPLICATION OF STATISTICS.

THE importance of accurate statistics scientifically assembled aud shown up cannot be overrated.

On the way this is carried out depends in considerable degree the progress or otherwise of a business or of an industry, and on it Germany has to a great extent based her industrial success.

In America the scientific assembling of statistics has developed into practically a new function and one of the greatest importance. It is called the "Control Department"; its head is designated controller, and ranks next to the general manager in business organisations.

The reason for naming the department "The Control" is because by the accurate and complete knowledge which it accumulates and mobilises concerning all the important activities in a business or an industry it affords a comprehensive grasp or control of that business or industry otherwise unobtainable.

In dealing with statistics you want a definite purpose for which you are assembling each set of figures. You want to apply them directly to the lesson you wish to convey; you require to draw all the figures necessary for your purpose to one point, so that instead of a series of calculations, possibly having

to collect the necessary figures from different places, you get by the graphic system, without trouble and exertion, a mental picture which can be comprehended at a glance and which fixes itself on the mind.

Statistics should always be graphed to compare with fixed standards as well as with the figures of the previous period, and the average over, say, ten previous periods.

Value of Statistics

The value of statistics lies in the lessons they carry for the future, and this entirely on the way they are assembled and shown up. You should set a standard for each important function and each important waste in the industry. The standard set should be as nearly as possible 100 per cent. perfection.

Take, for instance, the waste of fibre that takes place in scutching. The graphic system would measure your progress against the previous year, against the average over a period; but—and this is the most important point—it will also measure and show up vividly the amount of waste that is "still going on in this particular process as compared with the standard set.

Had the trade systematically collected and tabulated statistics by this process they would never have allowed such a colossal waste—the chief cause of the comparatively high cost of linen—to go unchecked for years.

But they had nothing to make them conscious and

remind them that such a waste was going on steadily from year to year, and it consequently escaped their notice.

There is waste in spinning. I am told that this is considerable. This should be treated statistically in the same manner, and many other places where waste is occurring will be shown up when you settle down in a systematic way to analyse your industry from this point of view.

The important advantage about handling statistics in comparison with standards is that the accent is always on the future, and at the same time the wastes that are still going on, the money and possibilities of expansion which are being steadily lost year by year, will be brought strikingly before the whole trade at regular intervals and can never be lost sight of.

By circulating statistics, scientifically assembled on this system, it will be quite impossible for the industry to get into a rut and remain there. Instead of dwelling ever on the past, the possibilities of future development and the elimination of waste are kept in the foreground. The mentality of the trade is kept dissatisfied with existing conditions and progress follows automatically.

In your Research Department you organise and departmentalise "progress." It is the dump for the ideas of the whole trade, where they will be worked out by minds scientifically trained for this purpose. The factory should be for production only.

Organisation is required before a Scientific Statistical System can be established

In the ordinary way, statistics are a "post mortem"; used scientifically, they become a "guiding star," an irresistible force compelling you to effort, and rendering progress automatic. All this means considerable thought; you cannot simply apply statistics to your industry as it is. You would require uniformity of practice, and to organise the whole industry, for a scientific statistical system. You would be well advised for this purpose to employ an expert, as it is no simple job, and requires skilled knowledge and experience. There are many functions in the industry that urgently require analysis and the application of statistics. It all comes down to the elimination of waste, and all waste comes under one of the three headings, "Time," "Effort," or "Material." To mention a few instance of functions requiring specific treatment—wages costings, loom and spindle efficiency, waste in all processes; labour conditions can also be treated statistically with much benefit. You require an annual balance-sheet for the whole industry, and your markets are crying out to be properly handled.

Effect of application of Statistics and Research on Markets.

Take the latter. You have figures showing your annual exports of linens and unions to all foreign countries, but this is all you have. You do not even know how much of this is pure linen, a most important matter; again, you do not know what the home market consumes. All the figures you have are "post-mortem" only; it is just as important to know

what your potential markets are as to know what your past year's sales amount to. You require to carefully analyse all your markets on a population basis, and also on the basis of wealth. This will show an amazing variation, and it is at this point that market research will come in to find out "why." In one market you may find that the wealth is in too few hands, and this will indicate an opening for fine high-priced goods. In another market you may find that the figures do not come up to the average, because the wealth has been made rapidly, and the population have not the education or the refined taste which lead them to buy a commodity such as linen. A condition such as this at once suggests advertising, as the *nouveau riche* are most susceptible to this treatment. They desire to "do the right thing;" they don't know how, they want to be told, and you should tell them that smart people use good linen.

But only analysis with statistics and market research can give you this valuable information. In all these cases you must keep careful statistics, and regularly compare results with standards of what each particular market should be capable of doing. You will then know how to concentrate on those which are not doing their duty and where there exist the greatest possibilities for expansion.

Need for Statistical Department in the Industry.

You require a statistical or control department for the industry, and the statistics for the whole industry should be handled by the one department.

This should be properly staffed and should have the most up-to-date machines for automatically sorting and tabulating statistics, such as Powers or Hollerith. I used these in Messrs. Butler Bros., and for this sort of work they are essential. Their advantages are speed, economy, and that with them you can compile statistics under many headings. One machine will do the work of fifteen clerks. A department such as this would not be an additional expense; it would be an additional economy.

The use of statistics is in reality a psychological question. Year by year you have been in the habit of comparing your figures with those of the previous year, and for that reason your exports have for years remained at approximately the same figure.

Aim higher, set yourselves standards after careful analysis, and in time you will as surely attain them.

This will project the mentality of the industry forwards instead of eternally dwelling on the past. It will automatically stimulate effort, and steady progress will result. All these things can be accomplished. I am building no castles in the air, but I would warn you that this is not the age of miracles. All development is gradual if it is to be permanent; it will take some years of concentration and effort before really great results can be looked for.

Without a scientific statistical system to measure progress and wherewith to direct its activities, you will not get 30 per cent. efficiency out of your

Research Department. Without this control research would be applied in a haphazard and unsystematic manner. It is the first function you would require to establish as a department in your scheme of reconstruction. It should direct and "control" all the activities throughout the whole industry, and it is the only means whereby standardised conditions can be attained. It is an essential in the systematic handling of your markets, and great care should be taken that the accurate information it mobilises is so assembled and shown up that the whole trade can easily assimilate it. You want to take each one of your markets, and at the end of every season the results should be shown up graphically on charts in comparison with

Research would be applied in a haphazard manner without this Department

1. The previous season's figures,
2. The average over, say, ten periods.
3. The standard or potential of that market based on its wealth plus population.

The selling of your finished product is the most important function in your whole industry; to this everything else is subsidiary. On the condition of your markets depends the prosperity of every branch of the trade. It is as important to spinners, weavers, bleachers, and finishers as to merchants. To them also should be circulated your sales statistics, so that all should have the fullest possible knowledge of the

actual position of the industry from this point of view, and also of the possibilities of expansion calculated on your scientifically prepared data. This would overcome that paralysing sub-conscious feeling of "finality" and would stimulate to more scientific handling of your markets.

I can assure you on the experience I have had of the American textile markets that there you have as yet only scratched the surface, that the possibilities of expansion are far greater than anyone in the linen trade imagines, and it is reasonable to assume that this will equally apply to your other markets also.

One cannot help realising that, after the long years of working to an ideal of individualism, it will be a wrench to begin to supply detailed figures of the sales in your various markets—that information which has always been considered most secret and most sacred.

But, in the first place, your statistical department should and would be run on as confidential lines as a chartered accountant's business ; secondly, it will be the same for everyone.

When you have taken the necessary steps, and your trade is in such a position that demand is always ahead of your power of production, you will find that all these old barriers will automatically break down.

In Ireland the linen industry is now completely organised into associations, and Scotland, no doubt, in self-defence, will follow suit. That action is the outward and visible sign that you have given up for ever the old principle of unbridled individualism, and have in its place accepted the principle of co-operation. Having accepted the principle of co-operation, for heaven's sake play it up for all it is worth; take all the value you can get out of it; it holds a rich store of prosperity for you if you will only avail yourselves of the opportunity. It will remove much of the harassing worry which characterises all individualistic business, and together you can with ease accomplish the big things which individually you could never have attempted. You people in the linen trade, both Scotch and Irish, are very intense. You have carried on your trade on the individualistic principle with such intensity that to a stranger coming in and analysing your problem it seems wonderful that it has ever survived, and he can only attribute its present condition to the great ability and industry of all those concerned. Apply these gifts, this ability, this industry, with the same intensity, the same thoroughness. Break away completely from the old secrecy, jealousy, and petty narrowness of the individualistic idea. Accept the co-operative principle whole-heartedly in your manufacturing, in your marketing, your scientific research, your statistical

department, in everything; and together your progress will be rapid and profitable, and the position of every one in the industry, large or small, employer and employee, will vastly improve. Having accepted the principle of co-operation, carry it through in an understanding and methodical manner. For this purpose a statistical department is your first necessity. You require uniformity in conditions and practice, and an effective knowledge, grasp, and control over every function and activity in the industry.

Only by means of a scientifically-organised statistical department can you bring this about.

SCIENTIFIC COSTS AND COST ACCOUNTING.

The position of America and Germany as regards "Scientific Costs."

IN 1913 a deputation from the United States, consisting of 550 of the leading manufacturers, merchants, engineers, cost accountants, and production engineers visited Germany. They went there by invitation, for the purpose of researching the industrial methods which were responsible for the amazingly rapid growth commercially of that country. Their visit was in every way a remarkable one. They were granted facilities for seeing and studying the methods of the largest and most prosperous concerns, from shipbuilding downwards. They spent six weeks researching this important problem, and they went home convinced that, in a greater degree than on anything else, the commercial prosperity of Germany was based on scientifically accurate cost keeping. As Mr. R. A. Franklin, of the Strathmore Paper Company, put it: "Cost is the basic—the fundamental improvement."

Subsequent to this visit the Federal Trade Commission, appointed by the U.S.A. Government and armed with compulsory powers, made an exhaustive research on the problem of costing methods over the whole industrial system of America, comprising 260,000 incorporated business concerns. The results were published in 1916, and to quote the Vice-President of the Commission, the Hon. Edward N.

Hurley: "Only ten per cent. of our manufacturers and merchants know the actual cost to manufacture and sell their products, 40 per cent. estimate what their costs are, and 50 per cent. have no method, but price their goods arbitrately. Most of the manufacturers and merchants who do not know what their goods cost are basing their selling price on what their competitors sell for, and with only this knowledge for a basis, they are frequently cutting prices and demoralising the industry in which they are engaged."

In Germany it is estimated that 90 per cent. of the manufacturing and merchanting concerns keep scientifically accurate costs.

This would appear a severe indictment by an American of American commercial practice generally —but don't jump to false conclusions on the matter the tendency of the whole business community is towards more scientific methods, and this 10 per cent. who know the actual cost are costing their products on systems that are scientifically accurate.

In the United Kingdom my enquiries lead me to the conclusion that there are only comparatively few firms who are developed up to such a point.

Secrecy, dislike to the interchange of ideas, and traditional objection to change are, perhaps, the real reasons. But, after all, accurate cost finding is just as important, probably more so, than accounting your money.

Cost Finding and Cost Accounting

In advanced practice cost finding and cost accounting are separate functions; time, labour, and material being just as accurately accounted as finance. Consequently, in its application, it requires the services of experts, and this is responsible for the rapidly-growing specialised professions of cost accountants and industrial or production engineers, who require to co-operate to produce the perfect system, and any business concern organised up to this pitch can produce and sell more economically than those which are not.

Where efficient control of production is in operation accurate costs come as a bye-product, the data required for one furnishing all the data necessary for the other. This is not an additional manufacturing expense—it is an additional manufacturing economy. Unless the cost of each line is accurately determined you cannot ensure that the selling price is sufficient to provide the margin of profit—you are working in the dark.

Estimated Costs.

What is considered good practice in this country would come under the heading "estimated costs" in the report of the Federal Trade Commission, the phrase "estimated costs" having different meanings in the two countries.

The fundamental difference between "estimated costing" and "scientifically accurate or actual costing" is that in the former you only arrive at your costs over a lengthened period, and they

are not only more or less estimated, but are also averaged over a period, therefore they do not give you the actual cost of manufacturing at the time of balance—a most important consideration. They also start from the wrong end—i.e., you work from the end of the period backwards; they are therefore a "post mortem" only, and could not possibly deal with the fluctuations of the present time. They may serve a purpose when values and prices run smooth, but to-day they are absolutely useless and will be so for many a day to come. How are you going to intelligently adjust prices when the market turns and values begin to drop? To serve their purpose costs require to be dished up red hot, not when they have become stone cold. After all what is costing for if not to take care of fluctuations, and this "estimated costs" cannot accomplish.

Actual Costs.

Actual costing is worked on quite a different principle. It begins at the logically correct place —"the beginning" and not at the end — it is synthetic. In the "work in progress account" you build up the cost of the product as you go along, and you can find the actual cost of each individual line at any time desired—you carry your balance-sheet along with you day by day.

Without knowing actual costs Germany could never have developed dumping and made it pay. This is perhaps the most scientific form of modern

commercial practice, and is worked to formula and curves.

This costing question affords another illustration of the weak spot in the older commercial method. In driving a motor you don't sit with your back to the engine—in steering a ship you do not face the stern. Why, in this more important problem, do men insist on eternally looking backwards, endeavouring to steer the ship of commerce by fixedly gazing along its wake, the motor of trade by contemplating the track of the wheels in the mud? The difference between the new and the old commerce is that in the former you are continually looking ahead, whereas in the latter you are always looking backwards.

Under the newer methods you know what actual cost is to-day, and are in the best possible position to gauge the future.

Under the older methods of estimated costs you merely ascertain in a general way the average cost at which your goods were produced over the past six or twelve months. This may be interesting from an historical point of view, but is of little assistance in controlling your business.

To-day, when commerce is becoming a matter of such International importance, you cannot as an industry afford to remain in ignorance of development in other countries, and this question of

scientific costing affords a reliable basis for comparison.

German commerce is 90 per cent. scientifically costed, the United States, 10 per cent., and Great Britain is scarcely in the picture. This is unpleasant, but there is no use shirking the issue. The United States freely admitted its inferiority to Germany in this respect, and sent its party of experts to the country to research the problem and find out "why," and is now in a systematic and practical manner setting about to correct this weakness in its commercial system.

evelopment Standard- ed Uniform ost System America

The Federal Trade Commission has, in an authoritative capacity, taken the matter up, and is assisting the manufacturers' and merchants' associations in developing statistical controls with standard uniform systems of scientific costing for their different trades. They hint that eventually they intend to apply for compulsory powers on the function of costing, so important do they consider it to the future development of their industries.

They are of opinion that this will be of great advantage to the American trade generally, as not only will it effect an immediate general improvement in costing, but it will also place the Commission in a position to circulate reliable statistics to each individual trade on this important function, which will show each firm how it stands

in regard to its cost with the average of the trade.

Addressing the Southern Pine Manufacturers' Association, Mr. Hurley stated that "A manufacturer who does not know with a close degree of accuracy what it costs him to produce the different articles he manufactures, and what it costs him to sell them, is not in a position effectively and intelligently to meet competition.

" Many of the larger manufacturers have thorough costing accounting systems, which they recognise as necessary in order to gain the information essential to successful management.

" On the other hand, the number of smaller manufacturers who have no adequate cost accounting system, and who price goods arbitrarily, is amazing. Proper cost accounting, for the small manufacturers especially, is most essential."

"Industrial Management," the leading American magazine on this subject, commenting on this, says: "As regards costs, the universal experience is that when all account alike, and each takes into consideration every element of costs, the evil of price slashing automatically tends to cease, for almost invariably the worst offender is found to be the man who knows least about his costs. When a man knows his costs within a reasonable degree of accuracy, he rarely sells below cost deliberately."

Will Great Britain follow suit?

The Commission hopes in course of time to develop standard forms of statement for each line of business, and thus to place the obtaining of credit on an absolutely scientific basis. First of course must come the establishment of uniform methods of cost accounting; hence the emphasis the Commission places on that subject at this time. This is the practical way in which America is tackling her problem, and can Great Britain afford to stand idly by when such systematised development in better business organisation by one of her largest rivals is proceeding at such a pace?

What is the Linen Trade going to do?

Might I suggest that scientific method in business organisation is as much a subject for your scientific research department as that form of science connected with technique only?

Were you to take two manufacturing concerns of equal size, one of which specialised on scientific technique, the other on scientific organisation, on the test of profits the latter would come out top every time.

But why not both? This combination would realise development in its highest and most remunerative form. The two largest firms — Messrs. Butler Brothers and the "Dry Goods Economist" — with which I have been connected, were advocates of costing in its most scientific form—indeed the Dry Goods Economist Organisation, which includes

lithographing, printing, and publishing, is a model in this respect.

Contact with scientific business organisations makes one familiar with and appreciative of its great superiority; but I have taken the precaution to have this article criticised by a friend of mine who thoroughly understands this subject, and who, as a matter of fact, was a member of the American party who visited Germany in 1913.

What is the Linen Trade going to do?

But the question before you is: "What is the Linen Trade going to do?"

It is an open secret that the question of standardised costs is exercising the minds of several sections of the trade in Belfast. If I were permitted, I would advise you to call in expert assistance. You do not require to laboriously toil over ground that has already been travelled by others before.

The underlying principles of scientific costing are just the same for ships as for pocket handkerchiefs. They only differ in detail, and you want to start off at the point of the best modern practice. Experts could straighten out your problem, saving you endless time, money and trouble. Standardised scientific costing should not be taken up separately by one or two sections of the trade. It should be taken up by the whole industry, otherwise it will lack uniformity. It should go along with your statistical or control department, for one is the complement of the other.

NECESSITY OF A POLICY.

AN idealist is classed by many with the pacifist, the unpractical, the crank governed neither by logic nor common sense. Please disillusion your minds at once.

One can have no patience with the individual who theorises without facts and expects Utopia without the evolution of a well-thought-out plan. He lives on theories, and invariably finds enough weak-minded fools to provide him a following. The harm he does to real progress is considerable. There are, however, such things as "practical ideals," which, if applied in a common-sense manner, are of the greatest value.

The word "Policy" defined.

In an industry like yours, which is gradually passing through a period of evolution, a complete change in its organic system from unorganised individualism to organised co-operation, unless it sets up for itself "ideals" common to all, a "policy" to govern its activities, is bound to make many mistakes, to drift this way and that, and lose co-ordination. One group will have one set of ideas, another will think antagonistically to the first; they will be at cross-purposes, and progress will be retarded to the detriment of all.

When sailing a ship you steer by chart and

compass, otherwise the ship will get off its course and never reach its port.

It is just the same in your industry. You are at a critical stage in its history, and unless you have a definite point to steer for, a "clearly-defined policy," to which all as associations and as individuals are working, you will lose co-ordination, you will drift, and divided opinion will hinder your development.

My last undertaking for the firm of Butler Brothers, before joining the staff of the "Dry Goods Economist," was a two years' trip researching the leading markets throughout the world.

Striking Features of German and Japanese Commerce.

This was a unique and valuable experience, and one of the things that struck me most forcibly was the way Germany, and in a lesser degree Japan, had built up their commerce to scientifically prepared plans governed by clearly-defined policies. They were working with an aim and a "purpose," scientifically co-ordinating and balancing all these distinctive functions which go to make up the full meaning of the word "commerce."

Their raw material, their manufacturing and research, their education, their finance, their propaganda and marketing—all these were systematically balanced, and to this is due their rapid growth. Against this sort of thing haphazard unscientific individualism cannot compete, and this is the lesson that must come home to all if we are commercially to survive the twentieth century.

Effect of Introducing a "Policy" into your Industry.

The ideals in an industry should constitute a carefully thought-out, "clearly defined policy," embodying a set of principles to which all its activities should be co-ordinated, and with which all should work in harmony.

Based on these principles and after careful analysis, working plans should be systematically prepared which would directly govern the various functions of the industry, thus rendering the principles effective.

If you have a policy your industry will be directed scientifically, economically, and progressively, and all the different wastes will be in turn located and eliminated as far as is possible.

Otherwise your industry will drift, production will not be economical, and progress (if any) will be slow and unsystematic. There is no middle course; it must be either the one thing or the other.

Has the linen industry a policy? If not, the associations would be well advised to get together and formulate the principles that are to govern their work of reconstruction, and also prepare the working plans which would render effective those principles.

The Principle

In the forming of your associations I have heard of one fixed principle to which you have worked; it is that "these should be organised on democratic lines, and that no firm, large or small, should suffer injury thereby."

This principle was understood by those who were

taking a lead in the formation of the associations, but had it been set out before the whole industry as a fixed principle in a definite policy with plans designed to render it effective, a great deal of the opposition encountered in forming the associations might have been obviated.

This principle is all to the credit of the linen trade, as in many other industries the larger firms have combined to crush out the smaller. But let us face the matter with our eyes open. There is no question that small, struggling firms have in some ways a detrimental effect on the economical working of an industry as a whole. Things are all right at the moment, but when the market turns and values begin to drop you will require to have a "plan" already prepared to meet the contingencies which will arise, otherwise your principle will fall down. The larger merchanting concerns will not appreciate those smaller firms which are financially weak unloading stocks and breaking prices for the whole industry, and if no steps are taken to obviate such an eventuality trouble will arise in your associations.

To render your principle effective you require definite working plans to meet contingencies such as this.

Suggested Plans to make your Principle Effective

Minimum price agreements are useful, but they are not complete without arrangements for carrying over periods of depression those firms that are not financially strong. But, whether or not there are

agreements, you will need to provide plans for finance, as very little pressure from this quarter will bring prices tumbling down, causing heavy losses over the whole industry, and it is, therefore, logically as much in the interests of the larger firms as of the smaller that your associations should make the necessary provision.

This is merely one example; there are many other important considerations on which it would be desirable to evolve a principle and to prepare the plans which would render it effective. You would require a council or parliament of the whole industry which would lay down the guiding principles, while the making of plans to render them effective would devolve to a great extent on the various associations. You would thus have progress systematised, balanced, and under control.

Some might think that this would prove too rigid in operation, but there is nothing to hinder you adjusting your plans when necessary, and this should be provided for periodically.

The newer commerce plans far ahead, making the necessary adjustments.

The older commerce made no plans; it merely drifted, without system, without balance, without co-ordination, and was never ready when trouble arose.

It is plain that if you have at the head of a firm two partners, one of whom would like to manufacture

a high quality product with a steady profit, the other preferring a low quality speculative trade, they will be working to different ideals. The two partners will be at cross-purposes, there will be disagreements, the one will spoil the efforts of the other, and that firm will not be successful.

A Clearly-Defined Policy is Essential.

It is just the same in an industry, and with the present tendency towards co-operation you should always think of it as one large concern, and you should endeavour to co-ordinate "thought" throughout its whole fabric, so that all may be working to the same "ideals," otherwise lack of harmony and divided counsel will hold you back. For this purpose a "clearly defined policy" for the linen trade, accepted by all, is essential.

For instance, is the industry to be run on a speculative basis or on a basis of steady profit? Are you going to continue waging civil war with one another in the markets of the world, or are you going to combine to extend, improve, and increase them? Are you going to adopt science and research so as to eliminate waste in a comprehensive and thorough manner, or are you merely going to play with this subject? Are you going to adopt the co-operative principle whole-heartedly, cutting out petty secrecy and jealousy, and in its place encouraging free, frank interchange of ideas? You cannot work to the individualistic and co-operative ideal at the same time without courting disaster. Are you going to

encourage improvement in quality so that your linen may enhance its reputation? Are you going to organise and encourage the growing of your own good flax at home, or are you going to take the risk of depending on outside supplies? Have you a policy with regard to labour? Are you going to extract the most out of labour at the lowest possible wage, or are you, on the other hand, going to adopt the policy of paying the best wages the trade can stand, expecting labour in return to co-operate and give good production?

You want to know exactly what this Policy is going to be.

It may be the one thing or it may be the other, but you want definitely to know. That is the point, otherwise the different associations and different firms will be working to different ideals; they will be at cross-purposes, confusion will result, progress will be slow, and many internal differences and trouble will develop. You require a "clearly defined policy," and you yourselves alone can frame it. My function is to point out its importance only; but whatever you intend to do, if it is to be carried out in the most effective manner you must have balance between the various functions in the industry. For instance, there is not the slightest use in setting out to increase production unless at the same time you take steps to extend and increase your markets.

I have talked with many members of the linen trade. All are agreed that the industry has got into a rut, and that changes on to more advanced lines

are necessary. Everyone has ideas on the subject, but they vary, and you require to crystallise all these varying ideas into one common "policy" for the whole industry, with which all your sectional associations and all the individual concerns should harmonise their activities.

One hears everywhere throughout this country contemptuous references to the habit of "muddle through," of "wait and see," but few seem to have any idea how to get away from this paralysing lack of policy. It is to a great extent a psychological question, and it is by the course outlined in this article that deliverance can be brought about. Just at this period when the spirit of the industry is stirring, when change is in the air, if you are too matter-of-fact and neglect the psychological side of the problem, it may rob you of the great success that is possible. You require to steer your industry by chart and compass, otherwise it will drift. "Common ideals," with a "clearly-defined policy," will provide that chart and compass.

COMPELLING REASONS FOR SCIENCE IN YOUR INDUSTRY.

NOTHING of marked achievement was ever accomplished except it was first a dream which stimulated imagination far ahead to see a vision of final result, and then having had the inspiration the result has been achieved by systematic, intelligent following of a policy.

Aim of Research Articles

Your Provisional Research Committee has by means of these articles striven to create an atmosphere for the linen trade from which it will draw in new life and inspiration—to will, to mobilise to the full for the opportunity which will arise after the war.

We have been a long time in awakening to the tremendous physical power the German Empire developed in the last half-century in organising to crush the nations of the earth.

With profound repugnance we have been forced to fight Germany with her own weapons—liquid fire, gas, bombs.

To fight her in the realms of commerce we are being forced to abandon our traditions of individual freedom in trade and submit our trade destinies to a centralised command in the handling of our commerce. Railways, shipping, banking, materials, and industries have been mobilised to a greater or less extent for the duration of the war. Have we learned

anything of the power of co-operation? Our whole scheme for the development of trade and industry for the next half-century is interested in the answer.

What War means in our day

Baker, the U.S.A. Secretary of War, has said: "War has become a thing of industry, commerce, and business. It is no longer a Goliath with his shield, spear, and sword, or a David with his sling that will decide the fate of the nation. To-day war is the conflict of smoke-stacks, the combat of the driving-wheel, the engine, and the loom banded together to fight the enemy. The nation or group of nations in modern war which is to prevail is the one that will be best able to co-operate and marshal its material industrial, commercial, and agricultural strength against the combination which may oppose it."

Germany's bid for Trade after the War

Some of us even now do not realise the powerful economic grip in which Germany held the world during the past two decades. While we were slighting her efforts she fastened on the world's markets. Even a conquered Germany will be relentless and a powerful enemy in the field of trade. If Germany is allowed to continue the process of peaceful penetration after the war she will again become a world menace in commerce no less than in the field.

It is not generally known that Germany, having ruined Russia commercially by organised Bolshevism, is now buying up at their depreciated value interests in Russian industrial concerns which will leave her

at the end of the war in control of Russian commerce.

This series of articles has been written for the purpose of leading the trade along to new lines of thought, broader vision for the future, so that it may pull itself together, reorganise on modern lines, and be in a position by employing science through research to eliminate waste, reduce costs, and largely increase its markets.

No longer will it be possible to continue, as in the past, competing madly against each other in the manufacture of the goods at home, and again as madly by your agents in the linen colony of New York city. Big lasting success is not the result of conquest but of co-operation.

Why is it necessary to get together as an industry? The answer is simple—Because you will have to meet in German and Austrian competition what many business men in America have come to regard as the bugbear, the root of the German cancer in commerce—viz., the cartel.

The "Cartel"

There seems to be a great lack of knowledge concerning the cartel. This is doubtless due to the fact that there may be several cartels in the same industry, and each industry handles its cartels in accordance with its requirements. Then, again, there are various forms of commercial combination in Germany known by different names.

The "monopoly" implies State control. The

"consortium" is a union of banks, which finances the sales of the monopoly. Or it may be a union of commercial, industrial, or agricultural concerns to underwrite or handle a given enterprise. Community of interests is another form, and really is an agreement or trust for the detriment of outside trade. But the real cartel, "Kartell," "Syndikat," "Verband," is different from the others, and is the evolution of a system begun in the middle of the last century. It is this cartel system still more highly developed which you must meet after the war.

The cartel has at its head the German State, and its aims are not commercial alone, but political to a high degree. No commercial contracts into which it enters are sacred or binding beyond the rule of expediency; it can always break faith on the pretext of the State's monopolistic rights.

The Growth of the "Cartel" System

When Prussia had consummated her atrocious plots against Denmark, Austria, and France, and had welded the German States into an Empire, she started out on her career as an industrial State. So rapid was the growth of German trade under the new system, irrespective of supply and demand, that the German system of "dumping" came into being. The cartel at the time was a combine within an industry to safeguard the home market by throwing excess production on foreign markets. This result was brought about by the military party, who taught the doctrine that German dominion over the world

depended no less on economic penetration abroad than on victories by the German arms in the field. As the general staff were working out plans for world domination, so the trade colleges, the Handelsakademien, were scientifically working out commercial campaigns for the domination of the world's markets.

The cartel became the most efficient means of crushing ruthlessly, relentlessly, brutally the competition of rival commercial powers. The system was a complex interweaving of banks and of interests co-related.

Method of Working

Their scheme succeeded and crushed out all opposition in the lines they attacked. Their approach to a market was no less methodical and thoroughly organised than the advance of their troops in the field.

Suppose a German linen cartel should attack you in North America, and decided on cutting prices considerably below yours, as they probably would, they would notify all the co-ordinated cartels, those of growers, spinners, weavers, dyers, bleachers, finishers, coal producers, etc., who would make the allowance of price necessary to cut you out of the New York market. Allowances would be arranged by the Abrechnungstelle, a special accounting bureau for the cartels. The German banks would finance the deal, and the German Ambassador at Washington would lend his assistance. The Government would

carry the goods to Hamburg free on the State railways, and could pay a special export bounty far in excess of the usual two marks per 100 kilograms which is allowed manufacturers on goods sent abroad. The whole German Empire is taxed to further the economic invasion of foreign markets through dumping by cartels. As soon as you were beaten out prices would again rise.

Before the war the United States, through the Sherman Anti-Trust law, was endeavouring to stamp out trade combinations; to-day she is encouraging them, and the Sherman Act is to be repealed. This is because it has been recognised, none too soon, that only by combination can the commercial menace of the cartel be defeated.

Menace of German Propaganda.

But these are not all the German methods that will be employed against you. They still have that most powerful weapon—propaganda; and when it is insidious, subtle, and cunning it is most dangerous.

Let me tell you how Germany has been using insidious propaganda to kill United States commerce in South America. Spain is the mother of Spanish America, and the latter fashions herself after the mother country. Even during the war the long arm of German intrigue reached from Cape Horn to the Mexican border, and the ground had been prepared and the seed sown many years ago.

The Germans make a speciality of cultivating men who control commercial and political power, and of

exploiting the ignorance of the masses in fostering their particular political ambitions. Hundreds of thousands of Spanish Americans are to-day implicitly convinced that their nationalities are doomed sooner or later to disappear, absorbed by Yankee imperialism, and their constant lamentations keep alive the idea of an unavoidable manifest destiny.

At the outbreak of war there were not more than 5,000 Germans in Spain; nine months ago there were 80,000. They are there to buy bargains off the Spanish bargain table at real bargain prices, stocks in Spanish banks, businesses, mines, public service corporations, newspapers, and railroads. £80,000,000 they had invested, and that was nine months ago. Their influence in South America after the war will be enormous.

"Printer's Ink" of February 14 quotes Manuel Gonzalez, Chief of the Latin American Trade Division of the National Association of Manufacturers in the U.S.A., as saying: "A persistent campaign of slander against the Allies and of commercial and political propaganda in favour of Germany keeps steadily upon a constantly increasing scale, but now specially directed against the United States."

To conduct this campaign the Germans have combined, forming powerful secret corporations, which operate in the different countries in accordance with a general plan, and the spending of huge sums of money to subsidise periodicals and newspapers in

every country, as well as other systems of publicity and suggestion. No methods of misrepresentation are neglected to stimulate fear and hatred of the supposed Yankee menace.

Dr. Paul Gart, of the great Commercial University of Aix-la-Chapelle, sums up the German slogan as follows: "Let us never forget that our great kultur mission in Spanish America is not only to conquer her markets but also to catch the souls of her populations."

German Banks.

Germany has four large banking institutions with powerful branches in each of the Republics, which were established years before the war, and, like the German banks everywhere else, their chief function has been to report through to the Central Cartel System the secrets of commerce with which they are entrusted in the usual course of business.

The German system of propaganda is so thorough and far-reaching in their determination to poison the minds of a people against the States that they even made use of itinerant pedlars called "Turcos," who travel thousands of miles into the interior on foot. These pedlars are subsidised to spread pro-German doctrines in the interior amongst the ignorant. One pedlar in Chihuahua circulated a sensational printed newspaper that the American fleet had been bottled up in the Hudson River by the Germans and destroyed in a battle off New York. This sort of intelligence creates among the ignorant the im-

pression that the Americans are poor fighters and cowards, and if the Spanish American has one contempt it is for a coward.

These are the reasons, and very compelling reasons, why the linen trade requires to-day to take stock of its position.

Everyone must now be aware that Germany, whether she wins or whether she loses, has ready for after the war a plan of concentrated industrial organisation far in advance of anything she has previously attempted, and in this education, finance, propaganda, science, research, scientific business methods, co-operative buying and marketing will be employed with an intensity hitherto unknown.

The Linen Industry must prepare for Post-Bellum Period.

In spite of their preoccupation with the war they have been systematically preparing and organising their post-bellum markets so that they may catch you napping—they have even been doing this in your own country, so Mr. Hughes tells us, and their underground influence has kept the Deutsche Bank alive for four years, and has made it difficult for the Governments of the Allies to come out with a strong commercial policy.

"Stocks are depleted," says the mentally lazy business man; "we will have a high old time filling in these depleted stocks after the war. Why worry about organisation, scientific research, developing markets? There is no need; we are quite safe."

Do these shortsighted stock-fillers really imagine

that the game of stock-filling is going on for time and eternity?

It will only go for a space, a much shorter interval than most people imagine. These will be the precious moments, and just on how you use them depends the future of the linen industry. International competition will follow such as none of us have ever experienced.

We were totally unprepared for war. Are we going to be equally unprepared for peace? Can the linen industry afford to wait complacently until competition such as this overtakes it? The time to prepare is "now."

"THE SCHEME."

IN this article the proposed scheme will be described, but before this the Provisional Committee wish me to state exactly their position in connection with the matter.

Appointment of the Provisional Committee and their Work.

They are a temporary Committee only, appointed by the "Committee of the Privy Council for Scientific and Industrial Research, on the recommendation of Professor M'Clelland, the Irish representative on that Committee. This is the same procedure that was adopted in all the other large industries, the reference to the Committee being to prepare a scheme of research for the whole linen industry of the United Kingdom, and to bring it before the Members by means of a propaganda campaign; in short, to start the ball rolling.

Their work is to prepare and suggest only, and when that is done a new Committee will be appointed by the various Associations in the Trade, on which the Scotch and English sections will be represented in proportion to their numbers. The Provisional Committee will then retire and the new Committee will take over and complete the arrangements.

The Writer's Personal Connection with the matter

As regards my personal connection with the matter, it was necessary for the purposes of the propaganda to employ some one to carry it through.

I understand that at the first meeting of the Provisional Committee several names were suggested, and it was decided to ask me to undertake the work. Just at that time it was possible for me to do so, I took it on, and am paid a fee for my services,

The "Scheme" in General.

In this article it is impossible to enter into minute details, and as a complete scheme will be submitted in course to all concerned, I am only attempting to deal with the subject in a general way.

In order to carry out the work and to secure the financial assistance which the Government is affording to aid industrial research, it is necessary to form an Incorporated Research Association, and for the formation of this Association the preliminaries are well in hand.

Those firms or individuals concerned in the linen industry who contribute financially will constitute the ordinary members, and from them will be elected the governing body or council, who will direct the operations of the research department.

It is suggested that the representation on the council shall be apportioned in an equitable manner over the various sections and interests in the industry.

The headquarters will be in Belfast, that being the largest centre.

At first, on account of the war, it would be

impossible to have your own laboratories and experimental stations, but as soon as circumstances permit these, with the necessary equipment, should be provided for as and when required.

In the meantime it is recommended that, if possible, arrangements should be made for the use of such facilities for research as already exist in the district.

Director of Research.

It is of the utmost importance to have at the head of the staff a thoroughly competent Director of Research. This is a difficult and exacting post, as it requires, in addition to executive ability, a broad knowledge of science in its various branches, and the best man obtainable should be selected, as the success of the research department depends to a great extent on the ability of the Director.

All the men qualified for this position are at present engaged on war work, but it is suggested that a selection should be made at the earliest date, and someone appointed who could take up the work immediately on the conclusion of the war.

The scientists employed should also be the best obtainable, as unless an undertaking of this sort is carried out in a thorough manner it would be better not to attempt it at all. It cannot be successful run "on the cheap."

The Committee have asked me to make it very clear that no results of importance can possibly be expected for some considerable time, though probably

in small matters improvements may be effected in a shorter period. To expect revolutionary results after a year or two would not be reasonable, and it would be most disastrous to the work carried on in the research department if, because it did not show immediate results, it were to be snowed under by destructive criticism.

Benefits to Members.

When the Research Department is established and in working order it is anticipated that each firm subscribing will enjoy the following privileges:—

1. It will receive a regular service of summarised technical information which will keep it abreast of the technical developments in the industry at home and abroad. To do as much for itself any firm would have to employ more than one man on its staff reading and translating the technical Press.

2. It will be able to obtain a translated copy of any foreign article in which it may be specially interested and to which its attention will have been drawn by the periodical bulletin.

3. It will have the right to put technical questions and to have them answered as fully as possible within the scope of the research organisation and its allied associations.

4. It will have the right to recommend specific subjects for research, and if the committee or

Board of the research organisation of that industry consider the recommendation of sufficient general interest and importance the research will be carried out without further cost to the firm making the recommendation, and the results will be available to all firms in the organisation.

5. It will have the right to the use of any patents or secret processes resulting from all researches undertaken.

6. It will have the right to ask for a specific piece of research to be undertaken for its sole benefit at cost price, and if the governing committee or Board approve the research will be undertaken.

Other Research Associations

In the annual report of the Committee of the Privy Council for Scientific and Industrial Research for the year 1917–18 it is stated that some thirty industries are actively engaged in preliminary work for the establishment of Research Associations. The Photographic, the Iron Manufacturers, the Scientific Instrument, and the Woollen Industries have already formed their Associations, and the Cotton Industry, Portland Cement Manufacturers, the Indiarubber Manufacturers, and Motor Manufacturers are on the point of completing their preliminary work.

The Iron Manufacturers' Research Association now represents 97 per cent. of the industry, and in

addition to starting research they have agreed among themselves that all existing knowledge, trade secrets, and procedures shall be pooled for the benefit of the whole industry. What an era of prosperity would dawn for the linen trade if they would do likewise!

The Financing of the Scheme will be dealt with in another article.

"FINANCING THE SCHEME."

WHEN a man is asked to pay out money, the first thing he generally wants to know is—what benefit he is going to derive from his outlay. There are two ways in which a man can derive benefit—(1) directly, (2) indirectly.

ery section the Trade efits either ectly or irectly m search

When the scientists in your Research Department invent a scutching machine which will give you 90 per cent. of the fibre on the flax crop as scutched flax, and only 10 per cent. as tow, instead of losing 50 per cent. of its value, as you are doing at present, the farmer and the scutch mill owner will benefit directly, but every section of the trade all along the line will also benefit indirectly. The farmer will have a larger yield of fibre per acre for the same outlay, and he will be able to sell his flax at a lower figure to the spinner; the spinner in turn will be able to reduce the price of his yarn; the weaver will be able to sell the cloth cheaper to the merchant, and the finished cloth will eventually reach the consumer at a lower price than before. The finished product is produced more economically, it will carry better wages and profit, and the lower price tends to make it saleable in larger quantity. Everyone concerned, therefore, derives a benefit either directly or indirectly—the farmer who grows the flax, the spinner, the weaver, the bleacher, the merchant, the whole district are

benefited; the distributor is also a gainer; the consumer, too, gets a share, through obtaining linen at a lower price.

Supposing, for instance, some machine were invented by which the spinners were able to get such an increased production that they were enabled to put their yarn on the market at a lower price, and a merchant commenting on this held that it did not concern him in the least, as the only section who benefited was the spinners, because they spun the yarn, would he not be reasoning illogically and erroneously?

It does not, therefore, matter to the individual firm or section in an industry like yours in what section betterments are effected. One section is bound to benefit directly, but all the others must also benefit indirectly—the merchant probably just as much as the spinner—for increased economy in production tends to increase the demand for the goods.

On the other hand, if the merchants—through some scientific method of selling and distribution—create an increased demand for linen, and handle and place their stocks of linen so that increased consumption results, the spinners also are gainers, for the demand on them for yarn will be greater.

There need therefore be no jealousy in the trade as to which section receives most benefit from the Research Department. Every section will benefit

equally, and all, without exception, should bear their proportion of the cost.

Economical production is brought about by the elimination of waste.

In commerce waste comes under three headings —time, effort, and material. It is the mission of research and science to wage eternal warfare against "waste," and in your case it does not matter where the waste lies—if research locates it and science eliminates it you will all benefit.

German Research

Before dealing directly with the financing of your Research Association, I would remind you that there are individual firms in Germany spending as much as £300,000 per annum on research, and in America practically all the large concerns find it necessary to have research laboratories, some of them, notably the Westinghouse, Kodak, and Goodyear Tyre Companies, spending up to and over £100,000 yearly in this way.

These firms are managed by far-seeing business men, who do not throw their money away for nothing. They put their money in research, because they find it pays them and has been an outstanding factor in their rapid success.

Foundation Fund

In other industries some of the larger firms, in addition to their annual payment, have donated money to create a foundation fund in order that their association may start off with sufficient funds to provide buildings and equipment, without having

to draw on their income for this purpose. Already in the linen industry several donations have been promised. In the cotton industry one donation promised amounts to £10,000.

Freedom from Income Tax and ExcessProfits Duties

By arrangement between the Government and the Privy Council Committee on Research, all payments, of whatsoever nature, to recognised research associations, are definitely exempted from income and excess profits taxation. This is because the Government believe that the future commercial prosperity of the country depends to a great extent on the application of science to industry.

In making up your annual income-tax returns, think of your contributions as an "expense," at all other times think of it as an investment, and one that will pay a handsome dividend in the future.

Government Grant

In addition to this, the Government have voted a grant in aid of industrial research, which is allocated pro rata on the amount contributed by the industry. This is made conditional on the firms in the industry entering into an agreement to contribute annually for five years a fixed sum, to be assessed on some equitable basis arranged among themselves, so that an annual income for the Research Association for at least five years shall be assured.

Method of raising Trade Subscriptions

After careful consideration of the various methods of raising subscriptions from the trade, it has been decided to invite firms to contribute on the basis of the capital they employ in their business, and to ask

them to enter into an undertaking to make an annual contribution on this basis for five years.

The following scale of contributions, with the amount of the annual subscription for each firm having a capital between certain wide limits, has been drawn up:—

Group	Amount of Capital	Annual Subscription
A	Capital under £17,000	£10
B	,, between 17,000 and £26,000 ...	15
C	,, ,, 26,000 and 40,000 ...	20
D	,, ,, 40,000 and 60,000 ...	30
E	,, ,, 60,000 and 90,000 ...	45
F	,, ,, 90,000 and 140,000 ...	70
G	,, ,, 140,000 and 200,000 ...	100
H	,, ,, 200,000 and 300,000 ...	150
I	,, ,, 300,000 and 500,000 ...	250
J	,, ,, 500,000 and 700,000 ...	350
K	,, ,, 700,000 and 1,000,000 ...	500

When the capital exceeds £1,000,000 the subscription will be £50 for each additional £100,000 or part thereof.

By capital is meant all capital employed in the business of the member in so far as flax or its products is wholly or in part used as the raw material for such business.

It will be provided in the Articles of Association that the capital shall be taken as shewn by the last available balance sheet in the year 1917, and shall include—

1. Loan indebtedness (including accommodation);

2. Reserve funds used in the business, and undivided profits.

The amount of capital to be determined by each firm's own auditor, and to be certified by him.

Against the first £5,000 subscribed by the industry the Government will contribute £5,000, and on any sum over and above £5,000 they will also contribute, but at a rate to be agreed upon later. It should, however, be stated that the Committee of the Privy Council on Research consider it would be necessary for the trade to subscribe a larger sum than £5,000 per annum.

The Duty of the Industry

From the above it will be seen that the call on each individual firm would be comparatively small, and that from the financial point of view there is nothing to prevent any firm, large or small, from taking its part in what will ultimately prove a paying investment, but which at the same time should be considered from the patriotic point of view as a national duty.

SCIENCE AND THE WORKER.

NO general scheme for the advancement of the industry will bring complete success unless the interests and the welfare of the workers are included.

The psychology, the human factor in the industry, is more than three-fourths of the whole, and the leaven of progress must work through the whole loaf so that it will rise altogether.

In the better times that are coming, industry scientifically conducted will understand and appreciate these things, and will look at them from a totally different point of view.

Before the war a newer and more enlightened school of thought was slowly developing, and the effect of the war will be to advance industrial thought throughout the whole country to a point which in the ordinary course it might not have reached in fifty years.

Prices

In discussing the question of wages in the linen trade there is one all-important factor that must not be missed: it is this, that the selling price of linen can reach a point where the public will refuse to buy it. The depreciated value of money makes this point look high to-day, but there is a great scarcity of textiles owing to so many looms and spindles being employed on Government work,

and the volume going into civil consumption is comparatively small.

Supply and Demand

Suppose Government work were stopped and there was sufficient raw material, at the present price of linen would the public consumption absorb the total output of the linen trade? I think everyone will be in agreement that this would be most unlikely.

Therefore after the war, under ordinary circumstances, prices would drop, whether we liked it or not, to a point at which the public demand would absorb the output of the industry.

Advertising

Advertising and propaganda, educating the public on linen and suggesting new uses for it, can increase the demand and also raise higher that point where the public demand for linen ceases; but even with advertising there is a point where the price gets beyond what the public will pay.

In the old days before the war, owing to price-cutting and lack of organisation among manufacturers and merchants, the price never reached that point, and much wages and profits were needlessly thrown away, but that does not alter my argument. There is a point beyond which prices cannot go, and all, whether employers or workers, are governed by that simple economic fact.

Now the selling price is made up of three factors:

(1) Raw material.

(2) Manufacturing and sales expenses.

(3) Wages and profits.

The maximum selling price fixes itself automatically by the demand from the public; therefore the amount to be distributed as wages and profits in a properly regulated industry is governed entirely by the economical manner in which raw material is produced and manufacturing and selling are carried out.

In the orgie of cheapness brought about by the fallacies of the old economic ideas held to—be it not forgotten by workers just as strongly as by employers—the fact was entirely missed that the workers of the country as a class were the largest customers of the manufacturers or producers.

Logically, then, if the workers receive higher wages they will have more money to spend, and a larger demand will be the result; but this depends on one condition—a most important condition—that is, economical production.

Cost of Production

If the prices of the commodities they use rise step by step with the wages, they are no better off with their higher wages.

What is required is that the wages should be high, and that the cost of living should be low, but only economical production and distribution can bring this about.

Money is only counters, after all, a convenience for exchange. The workers exchange their labour for money, and exchange their money again for those commodities which constitute the necessaries

and comforts of life. It is the commodities that count; you can't eat money.

Cost of Living

Workers are the largest consumers of merchandise; therefore in their own interests they should see that production is economical; otherwise they put up prices against themselves, and they should give their assistance and co-operation in everything that tends to reduce the cost of production, provided of course that they receive their due reward.

Restriction of Output

Restriction of output is quite understandable in those industries which do not take the trouble to sell and distribute their products in a scientific and thorough manner, but restriction of output is a dangerous weapon, for it cuts both ways—it puts up the cost of the necessaries of life to everyone, including the largest consumer of all—the working man.

We have no restriction of output in America, and the coal miners there bring to the surface three times per head the amount of coal that your miners do here.

They are always eager to employ labour-saving machinery, and so, though they earn much larger wages in consequence, the coal costs less to everyone.

Shipbuildin in the Unite Kingdom an U. S. A.

Take the shipbuilding industry in the United Kingdom. In Belfast you hold every record for output, and have every reason to be proud of it; but, generally speaking, restriction of output is strongly

prevalent in this industry. Men are only permitted by their unions to do a certain amount of work in the day, and hand riveting is still the rule, as the unions object to labour-saving machinery.

They were able to do this because before the war the United Kingdom had what amounted to a monopoly on shipbuilding, and no matter what the level of prices was, everyone had to come to Great Britain for ships.

Immediately after the war, for possibly three years, all shipyards will be intensely busy making up the tonnage destroyed by submarines, but after that what?

The United States has put down slipways which, with their scientific methods of rapid standardised production, can produce three to four times the world's pre-war output of tonnage.

There will be no restriction of output. Every machine that can speed up production will be employed freely; the ships will be built on the Ford principle, under the best known system of scientific management; the wages will be high, but the cost of the ships, owing to rapid production scientifically carried out, will be far below what they can be built for in this country.

Think of the Ford car concern—the highest wages, the highest profits, and a product, the Ford car, the best value for money in the world.

This has been brought about by rapid production,

due to science being brought to bear on it at every point.

With ships being built on the Ford principle in America there are hard times for the shipping industry here. If the workers in the shipyards in Belfast in their own interests took the right view of the situation they would not stand satisfied with the records they have achieved over the shipyards in the United Kingdom, but they would move heaven and earth so that those yards on which their livelihood depends were brought to the highest point of rapid economical production.

Economical production induces larger sales; and the Ford organisation is highly scientific, and one of its principles is that in all improvements which bring about increased economy in production the concern, the employees, and the public should all share the benefit.

Can high level of Wages be Maintained

But to get back to the linen industry. Wages have now reached a comparatively high level; after the war can that level be maintained? It may or it may not.

I know that the spirit with which the employers view this question to-day is that the highest wages consistent with selling the goods must be maintained.

But everything is governed by what the public will pay, and if the public will not pay the necessary price for linen, unless we can produce more economically wages are bound to come down, and neither

strikes nor restriction of output will prevent them. There is only one way to maintain or to raise wages, and that is economical output.

High wages and economical output must go hand in hand. Therefore if wages and profits are to be maintained it is necessary to make a united effort to reduce the cost of production.

Great scope for Scientific Research in your Industry

It is for this purpose that scientific research is being started in a systematic way in the linen industry, Science aims at the elimination of waste, and it is the waste of time, effort, and material which builds up the high price of any commodity.

I cannot tell you the exact point where science will touch your industry beyond that I know there is tremendous waste of raw material due to unscientific methods in scutching and retting, and this adversely affects your wages; but there is no doubt it affords a wonderful field for research, and of a certainty in time great economies will be effected which will bring about more economical production, with benefits which will improve the condition of everyone in the industry. To take full advantage of this development the co-operation of the workers is necessary.

Co-operation of Employers and Workers is necessary

You want team play, and if your employers and workers co-operate in order to get the industry on the highest level of prosperity all concerned, including the public, are bound to benefit. You want to get the best value for your higher wages when you

go to spend them, and this can only be effected by getting economical production.

You may argue that workers do not buy linen. There is no reason why, with higher wages and more economical production, linen will not some day be well within their reach, but this does not alter my argument. Clothes, boots, foodstuffs, are all products of mills and factories, and unless they are produced economically the cost of living will be high.

How Science touches the Workers

Science touches the workers directly in many ways—heating, lighting, ventilation, and working conditions generally. The science of fatigue, which is now attracting increased attention, is another important development which will benefit the workers directly.

Improved education will also tend to equalise opportunity. Most people take scare at the word "science." It means "accurate knowledge." I have heard science defined as the "best and easiest way to the desirable things of life."

What the worker wants is less drudgery in the daily routine of his work—shorter hours and more of the necessities and comforts of life.

Economical production through increased scientific knowledge and practice in process and machinery and in the organisation and management of industry alone can bring this about.

This is why a department of research is being started in the linen industry.

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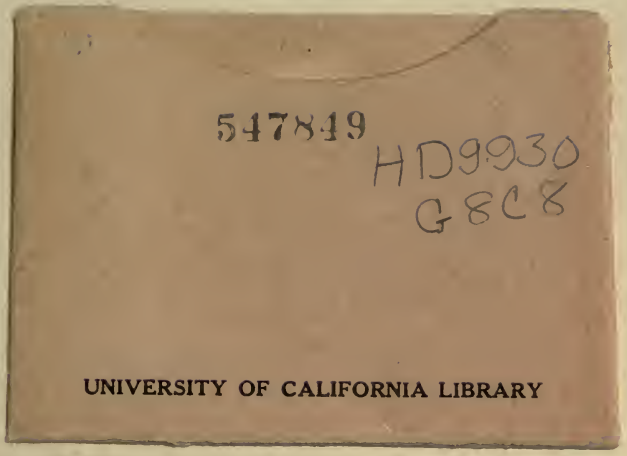
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